

# John F. Kennedy Space Center

## SHUTTLE PROJECTS OFFICE

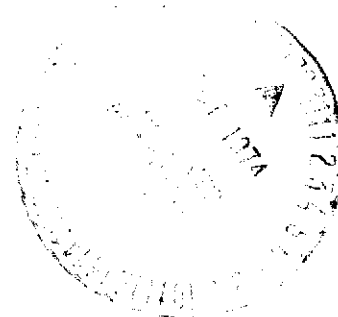
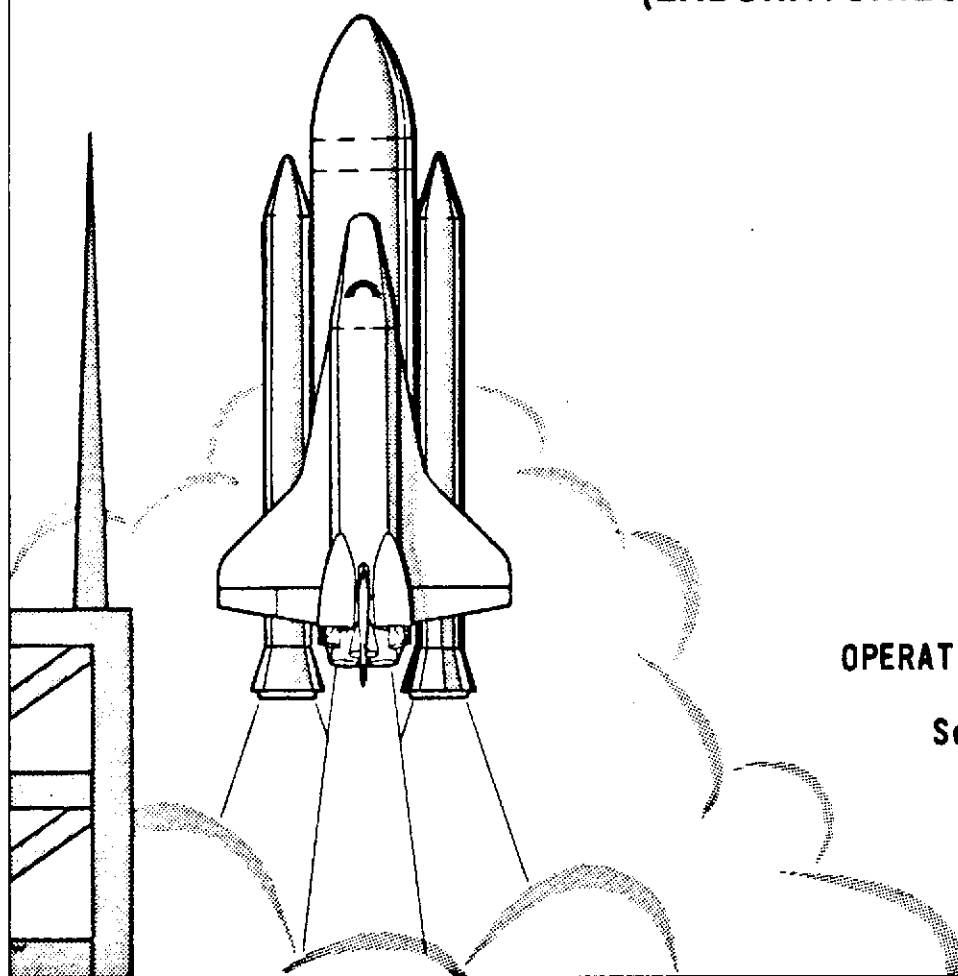
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### KSC MAINTENANCE CAPABILITY (LABORATORIES AND SHOPS)



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## PREFACE

The capabilities of the various facilities at the John F. Kennedy Space Center are indicated in this document by statements that describe what has been done, is being done, and by inference what can be done. Personnel in each of the laboratories and shops are well trained in the expertise required, and the necessary level of experience has been achieved. Together, these personnel and facilities comprise the KSC Maintenance Capability. This document is provided as a direct result of the efforts of the Offline Maintenance Management Panel (Offline Maintenance Management Plan, K-SM-12-1).

Certain base support services are not included in this document, nor are development areas such as those assigned to Design Engineering (DE) (Bench Maintenance Equipment, Launch Processing System) or to the Information Systems Directorate (IN) (Central Data Facility).

The format of this document is a listing of facility identification, location, area square footage, function, and equipment. The equipment paragraph is general. More detailed equipment lists are presented in Appendix B for some facilities. These are not complete listings. Equipment Visibility Files are available that provide the model, nomenclature, location, cost, etc. of all equipment of a non-expendable nature.

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## SECTION I

### MEASUREMENT LABORATORIES

#### 1.1 GENERAL

Laboratories are located at the Central Instrumentation Facility (CIF, Building M6-342. See Figure A-1) to develop, procure, test, maintain, and repair instrumentation for routine and special measurement requirements. Component testing is performed in these laboratories to evaluate state-of-the-art in the areas of measuring transducers, signal conditioners, data acquisition systems, and recording media.

The Measurement Laboratories also calibrate transducers and subsystems required for measuring activities. These laboratories recondition damaged and broken transducers and signal conditioning equipment, and maintain the stock of transducers required for measurements. Environmental testing facilities and services at these laboratories include temperature, altitude, humidity, pressure, acceleration, vibration, shock, and toxic hazards.

Special Wave Analysis Laboratories are located in the CIF to analyze vibration and acoustic data. Engineering and statistical analysis of complex waveforms is performed in these laboratories. Data analysis results are compiled, published, and distributed to cognizant users. Summary studies and reports are provided as required.

#### 1.2 PRESSURE/TEMPERATURE LABORATORY

Location: CIF, Building M6-342, (see Figure A-1) Room 144

Area: 946 Square Feet

Function: Calibrate gage, differential and absolute pressure transducers, and all types of temperature measuring equipment such as resistance thermometer probes, platinum surface sensors, and self-powered reference junctions. Strain gages and displacement measuring devices are also calibrated in this laboratory, and the laboratory is equipped with a universal load frame for subjecting test specimens to compression and tension loads to 50,000 pounds.

Equipment: This laboratory uses a special oil bath, freezing point standards, clamshell furnaces, cryogenic calibrator facility in addition to many other types of specialized equipment.

#### 1.3 VIBRATION LABORATORY

Location: CIF, Building M6-342, Room 148

Area: 275 Square Feet

Function: Calibrate accelerometers used in support of launches. (Calibrations are traceable to the National Bureau of Standards.)

Equipment: This laboratory uses calibration equipment specially designed and patterned to accept the various types of accelerometers utilized at KSC.

#### 1.4 TOXIC/HAZARDOUS GAS LABORATORY

Location: CIF, Building M6-342, Room 138

Area: 352 Square Feet

Function: Calibrate and maintain different varieties of toxic vapor detectors, UV detectors, and hydrogen gas detectors.

Equipment: Precision instruments necessary to calibrate and maintain the various detectors.

#### 1.5 MEASUREMENTS COORDINATION LABORATORY

Location: CIF, Building M6-342, Room 143A

Area: 436.5 Square Feet

Function: Responsible for scheduling, coordinating, and compiling information concerning measurements and related systems utilized by the Measurement Systems Division. Compilation and distribution of a weekly printout tabulation of facility and environmental measurements throughout KSC.

Equipment: The latest data processing equipment is used to keep inventories current.

#### 1.6 METEOROLOGICAL LABORATORY

Location: CIF, Building M6-342, Room 351

Area: 780 Square Feet

Function: Modify, repair, and calibrate wind speed and wind direction measurement equipment, electric field meter (lightning) measurement systems, ultraviolet light detectors, corona current measurement systems, and other meteorological systems. The Laboratory also functions as an advisory group.

Equipment: Precision instruments and equipment necessary for the repair, modifying, and calibration of the meteorological measuring, sensing, and indicating instruments and apparatus.

1.7 ACOUSTIC LABORATORY

Location: CIF, Building M6-342, Room 150

Area: 258 Square Feet

Function: Calibrate a variety of microphones used in the support of launches and other special applications.

Equipment: Anechoic chamber, microphone calibrators, and many other types of systems.

1.8 SIGNAL CONDITIONING LABORATORY

Location: CIF, Building M6-342, Room 262

Area: 528 Square Feet

Function: Repair, checkout, and provide modification on all types of signal conditioning equipment used in conjunction with the various types of measurements performed by the Measurement Systems Division.

Equipment: Preston amplifier and assorted general - purpose bench test equipment.

1.9 PROTOTYPE LABORATORY

Location: CIF, Building M6-342, Room 143

Area: 633 Square Feet

Function: Ensure that prompt, efficient action is taken when problems arise involving cabling, potting, or special hardware modifications in support of measurement systems at KSC.

Equipment: Cable wrapping machine, cable tester, sleeving cutter, insulation testers, etc.

1.10 WAVE ANALYSIS LABORATORIES

Location: CIF, Building M6-342, Rooms 276 and 282

Area: 1,608 Square Feet, Total

Function: Perform engineering and statistical analysis of complex wave forms. The ground and environmental data recorded for the Apollo/Saturn Program by the Measurement Systems Division is an example of the data analyzed and reported by the Wave Analysis Laboratories. Other data are handled upon request. Data recorded on analog tape can be analyzed by the laboratories. Other data analyzed typically includes telemetry data for both Saturn and Minuteman as well as acoustics for the Titan IIIC.

Data analysis capabilities are in the frequency and time domains and include amplitude and power spectral density analysis, auto-correlation, cross-correlation, cross-power, amplitude probability to 6 sigma, time histograms, and raw data oscillographs.

Equipment: Audio frequency spectrometer, audio spectrum analyzer, recorder/reproducer, x-y plotter, oscillograph, vibration analysis system, etc.

## SECTION II

### INSTRUMENT CALIBRATION AND REPAIR

#### 2.1 GENERAL

Calibration and repair of instruments is provided by the Kennedy Space Center (KSC) as one of the base support functions to its stage, spacecraft, and support contractors. Laboratories for this purpose are located in the Operations and Checkout (O&C) Building, Central Instrumentation Facility (CIF), and Vehicle Assembly Building (VAB). Operations of these laboratories are in compliance with the Apollo Metrology Requirements Manual, NHB 5300.2, dated December 1965. This document provides overall NASA guidance on calibration.

In order to provide the support required, three general area of operation have been organized, staffed, and equipped. These areas are a reference standards laboratory in the CIF, Building M6-342; calibration laboratories in the CIF, O&C, VAB; and a support group to give both standards and calibration necessary specialized support. Each of these functions is briefly described in the following paragraphs.

#### 2.2 REFERENCE STANDARDS LABORATORY

The Reference Standards Laboratory maintains all KSC reference standards. Equipment is available to transfer this reference standard accuracy to the working standards and other test equipment in use at KSC. The Reference Standards Laboratory is subdivided into six sublaboratories located in the CIF.

##### 2.2.1 ELECTRICAL AND MICROWAVE STANDARDS LABORATORY

Location: CIF, Building M6-342, (see Figure A-1) Room 105

Area: 902 Square Feet

Function: Instrument calibration standards for emf, resistance, frequency, phase angle, inductance, and capacitance.

Equipment: Epply Saturated cell bath and Wenner bridge with Thomas standard resistors, a cesium frequency standard, dc-ac thermal transfer equipment, six-dial potentiometers and volt boxes, and precision inductance and capacitance bridges.

##### 2.2.2 DIMENSIONAL LABORATORY

Location: CIF, Building M6-342, Room 106

Area: 614 Square Feet

Function: Measure and calibrate length, angles, roundness, hardness, flatness, and other dimensional parameters.

Equipment: Gage blocks, flatness and pointing interferometers, precision rotary table, three-coordinate and long-length measuring machines, gage-block comparators, micro-hardness machines, and similar equipment.

#### 2.2.3 PRESSURE LABORATORY

Location: CIF, Building M6-342, Room 127

Area: 456 Square Feet

Function: Measure and calibrate pressure devices up to 100,000 psi. Measure and calibrate vacuum devices. Measure surface finishes and dimensions (diameters) of materials, etc.

Equipment: Deadweight piston manometers, precision manometers and barometers, internal diameter comparators, surface-finish machine, precision McCloud gages, and hook gages.

#### 2.2.4 MASS-STANDARDS LABORATORY

Location: CIF, Building M6-342, Room 117

Area: 390 Square Feet

Function: Calibration of weight sets and other weight measuring equipment.

Equipment: Class S, S-1, and M standards from fractional parts of a gram (or ounce) to 50 pounds; complete range of single-pan balances.

#### 2.2.5 TEMPERATURE STANDARDS LABORATORY

Location: CIF, Building M6-342, Room 104

Area: 491 Square Feet

Function: Measure temperatures from 4° to 3,000° Kelvin, calibrate temperature measuring equipment.

Equipment: Primary temperature points, helium-point apparatus, and cryostat for cryogenic measurements and oil baths.

#### 2.2.6 VERIFICATION LABORATORY

Location: CIF, Building M6-342, Room 125

Area: 890 Square Feet

Function: Select random statistical samples of the instruments calibrated in the calibration laboratories and verify the accuracy of their calibration.

Equipment: Precision measuring equipment for checking the accuracy of calibrated electrical, electronic, temperature, weight, and other types of measuring equipment.

## 2.3 CALIBRATION LABORATORIES

The Calibration Laboratories calibrate all commercial test equipment, both portable and that installed in GSE, and all hand tools that belong to the stage, spacecraft, and support contractors at KSC that can be calibrated.

### 2.3.1 CIF CALIBRATION LABORATORY

Location: CIF, Building M6-342, Rooms 107, 112, 112A, 116, and 136

Area: 4,498 Square Feet (1,691 sq. ft. is RF shielded, 2,807 sq. ft. is laminar flow)

Function: Calibrate and repair precision electrical, mechanical, and pressure instruments.

Equipment: Digital and differential voltmeters, precision bridges (Wheatstone, Mueller, and impedance), decade boxes, potentiometers, sine-bars, gage and angle blocks, transits, levels, theodolites, thread gages, etc.

### 2.3.2 O&C BUILDING CALIBRATION LABORATORY

Location: O&C Building, M7-355, (see Figure A-1) Room 2221

Area: 2,440 Square Feet

Function: Calibrate electronic instrumentation and mechanical hand tools.

Equipment: Precision equipment for calibrating spectrum analyzers, oscilloscopes, precision power supplies, electronic counters, oscillators, signal generators, etc.

### 2.3.3 VAB CALIBRATION LABORATORY

Location: VAB (see Figure A-2) Rooms 1E21 and 1E22, and the 16th floor of Tower A.

Area: 6,720 Square Feet

Function: Calibrate electrical, electronic, microwave and mechanical instruments, etc.

Equipment: Precision instruments for calibrating the various types of electrical, electronic, mechanical, and other equipment.

#### 2.4 CALIBRATION SUPPORT

A recall system is operated to notify all users when calibrations are due, when calibrations are complete, and when calibrations are past-due. In addition, a wide range of technical and management information on the subject of calibration is reported from the information generated by this system.

There are three instrument loan pool and staging areas. Loan pools provide short-term loan of a wide variety of electrical and electronic test equipment. The Equipment Visibility Files includes these items. Staging areas are areas where equipment is received for calibration and returned to the user after calibration. One loan pool and staging area is located in Room 12B8 of the VAB and occupies 4,100 square feet of floor space, one is located in Room 2273 of the O&C Building and occupies 2,000 square feet of floor space, and one is located in Room 132 of the CIF and occupies 500 square feet of floor space.



## SECTION III

### TIMING AND COUNTDOWN

#### 3.1 GENERAL

The KSC Timing System consists of equipment installed at the Central Timing Station located in the Central Instrumentation Facility (CIF), and remote sites at the Launch Control Center (LCC), Vehicle Assembly Building (VAB), Pad Terminal Connection Rooms (PTCR), Launcher Umbilical Towers (LUT), Operations and Checkout (O&C) Building, and the Spacecraft Fluid Test Complex for the particular service required in those areas. (See Figures A-1 and A-2).

Timing signals are transmitted from the Central Timing Station via cable to major locations. Timing terminal units are supplied to the equipment areas of using activities. A modular design approach allows expansion of the components of the system to accommodate the timing requirements of anticipated future activities. Updating the precision of generation is accomplished by additions to the Central Timing Station only. Subcentral (slave) distribution stations carry this distribution to the terminal units.

#### 3.2 CENTRAL TIMING STATION

Location: CIF, Building M6-342

Area: 950 Square Feet

Function: The KSC Timing System performs the following specific tasks:

Provides an extremely accurate and stable source of timing signals at rates and in formats consistent with the demands of all area instrumentation, monitor, control, display, and analysis requirements.

Maintains timing synchronization with, and provides precision discrete frequency signals referenced to, universal primary standards and the Air Force Eastern Test Range (AFETR).

Generates, distributes, and displays countdown signals, and distributes these with timing and frequency signals, to all NASA and other activities within KSC.

Distributes launch-related, and other event correlation signals throughout KSC.

Equipment: The Central Timing Station contains the necessary equipment to generate accurate time and frequency signals which are distributed via cable to all KSC locations. Each of two identical sets of equipment located at the Central Timing Station consists of a reference oscillator, a time-base generator (accumulator), code generators, and timing signal transmitters. This redundancy provides for the confidence level consistent with the required reliability factors. Synchronization with the AFETR to assure synchronization. Provision for this is made by reception of the UHF AFETR time transmission. Time and frequency signals are continuously compared with signals received from National Bureau of Standards and the U.S. Naval Observatory radio transmission in order to verify the precision of generation.

## SECTION IV

### ELECTROMAGNETIC COMPATIBILITY (EMC) AND ANTENNA FACILITY

#### 4.1 GENERAL

The EMC responsibilities include: (1) determining the RF spectrum characteristics of the launch vehicles and associated GSE, (2) making RF field-strength surveys at KSC facilities, (3) conducting tests to verify compliance of RF devices with RF interference (RFI) suppression specifications, (4) making measurements of signal levels on systems grounds to minimize the effects of ground loops, and (5) verifying the shielding effectiveness of shielded rooms.

The EMC Facility operations utilize several mobile units, (vans) the Electromagnetic Laboratory (EML), and the Frequency Control and Analysis (FCA) Support Area.

The Antenna Facility operations utilize an operations/laboratory building, a boresight tower, various antenna structures, and an equipment building for standby generator power.

#### 4.2 EMC VANS

Location: Mobile-Van 1, HE 703-002; Van 2, HE 703-037

Area: 35 feet long by 96 inches wide by 13 1/2 feet high

Function: Perform measurements, tests, etc. as follows:

- RF Field Strength
- Frequency
- RF Spectrum Occupancy
- RF Susceptibility
- RF Signal Source
- Signal Location (DF)
- RF Site Surveys
- Xenon Lamp Acceptance Tests
- TM Data Recording
- RF Interference Location
- RF Systems Calibration

Equipment: The vans contain an RF shielded enclosure which is equipped with RF signal sources, receivers, frequency counters, communications equipment, timing units, and recording equipment. A set of antennas is mounted on top of the vans. The vans are self-propelled and are equipped with facility air conditioning and ac power generators. Van 2 is equipped with an on-board mini-computer.

#### 4.3 EML

Location: Building M6-336 (see Figure A-1), Rooms 102A, 102B, 103, 105, 106, 108, 109, 111, 113, and 116

Area: Total building area is 7,567 square feet, but the portion utilized by EML is 3,869 square feet, allocated as follows:

- Two RF shielded areas - 704 total square feet
- Three laboratories - 930 total square feet
- One drafting room - 352 square feet
- Two logistics and storage rooms - 590 total square feet
- One fabrication room - 171 square feet
- One data reduction room - 90 square feet
- Engineering and administrative office space totaling 1,032 square feet

Function: Test and evaluate Emergency Egress Radio transceivers for space shuttle.

Fabricate Peak Voltage Monitor units to measure lightning induced voltage on mobile launches.

Perform RF emission tests, per Military Standard, on lighting samples to be used in the CIF.

RF radiated and conducted susceptibility testing of electrocardiograph equipment used in Occupational Health Facility.

Equipment: The EML Building is air conditioned, has a paved parking lot, and provides outside power outlets for powering the EMC mobile laboratories when they are parked at the facility. The EML contains a wide variety of electronic test equipment, both general and specialized.

#### 4.4 FREQUENCY CONTROL AND ANALYSIS (FCA) MOBILE LABORATORIES (UNITS)

Location: Mobile - Two units, two vans per unit

Area: 30 1/4 feet long by 96 inches wide by 10 1/3 feet high

Function: The FCA Mobile Units are divided into two basic systems - the Spectrum Surveillance System and the Radar Beacon Checkout System. Both systems operate essentially independent of each other, and can be operated simultaneously.

The Spectrum Surveillance System is capable of detecting, direction-finding, and analyzing electromagnetic radiation throughout the frequency spectrum from 500 KHz to 16 GHz. The purpose of the system is to provide triangulation data for the employment of "chase techniques" in the locations and suppression of electromagnetic interference at various stations of the AFETR and KSC. This system is also designed to monitor and analyze range instrumentation for signal quality.

The Radar Beacon Checkout System is capable of measuring the peak power output, receiving sensitivity, recovery time, reply relay, frequency, and pulse characteristics of S and C Band missile-borne beacons. Radar beacon checkout is accomplished by locating the system in the launch area and transmitting interrogation data to the missile. The beacon reply is analyzed to determine the operational acceptability.

Both systems embody semiautomatic test programming and self-check features to permit rapid equipment checkout or signal analysis. The methods of testing, results of test, and operating consoles have been designed and arranged to permit precise measurement of critical parameters in a minimum time and to minimize the error due to improper operation, calibration, and display interpretation. Many test results are automatically recorded, and others may be voice recorded by the operator. Two-way voice communication may be carried on between the mobile units and range stations.

Equipment: These self-contained, self-propelled, air-transportable, special purpose vehicles contain power generators, air conditioning equipment, and other equipment necessary for complete and independent operation.

Each van contains 13 racks of equipment containing receivers, display units, patch panels, amplifiers, counters, meters, control panels, recorders, power supplies, RF generators, television equipment, and other electronic circuits for spectrum analysis and the measurement of beacon parameters. The vans also contain a desk and plotting board.

The top of each van contains seven omnidirectional antennas, five direction-finding antennas, one beacon receiver antenna, one beacon transmitter antenna, and one transceiver antenna. A television camera is mounted on the beacon antenna pedestal.

#### 4.5 FCA SUPPORT AREA

Location: FCA Building, L5-683 (see Figure A-1), Rooms A-6, A-10, A-11, A-12, and A-13 plus three special (high clearance) parking bays for the FCA vans.

Area: 2,699 square feet of this 9,245-square foot deactivated Air Force FCA facility is utilized by the FCA function.

Function: Check out and calibrate the van systems, and storage of equipment.

Equipment: The FCA portion of this temperature-controlled building is equipped with:

- One AN/DPN-66 Radar Beacon Transponder
- One low-voltage power supply
- One transponder control panel

#### 4.6 ANTENNA FACILITY

Location: Building L7-1557, Boresight Tower L7-1760 (see Figure A-1)

Area: 7,735 Square Feet

Function: Receive, automatically track, perform signal conditioning, record, and retransmit RF signals for frequencies from 100 MHz to 4,300 GHz. Provide support during checkout, launch, and orbital phases of Apollo, Skylab, ULO missions, and various Air Force/Navy missions.

Equipment: Antennas, recorders, receivers, and numerous other equipment such as digital, test, calibration, and ancillary.

## SECTION V

### COMMUNICATIONS SHOP MAINTENANCE CAPABILITIES

The Communications Maintenance and Storage (CM&S) Facility is a totally air conditioned KSC Industrial Area building having both truck and railroad unloading dock facilities. East of the building is 53,000 square feet of pavement for trucks unloading and vehicle parking (36 spaces). West of the building is a paved parking lot 60 feet by 285 feet with 62 parking spaces.

Location: Building M6-791 (see Figure A-1)

Area: 29,000 square feet

Function: Serve as a maintenance shop and supply area for checkout and repair of communications equipment. Maintain equipment and systems as indicated in the following table.

Table 5-1. Basic Communications Systems Maintenance Identifier

		Test & Checkout Equipment Used	
System	Maint. Level Performed	Special	Standard*
Communications Centers (Teletype & Crypto)	1, 2, 3		x
Public Address & Paging	2, 3		x
Mobile Radios	1, 2, 3		x
Operational Radios	2, 3		x
Operational Intercommunications Systems (OIS)			
Radio Frequency (RF)	2, 3	x	x
Audio (A)	2, 3		x
Headsets	2, 3	x	x
Operational TV System	2, 3		x
KSC TV Studio	2, 3		x
Data Transmission System	2, 3		x

\*Normally available as off-the-shelf item from manufacturer.

Equipment: Power supplies, signal generators, oscilloscopes, various meters and other equipment necessary for the proper maintenance and repair of electronic circuits.

## SECTION VI

### MALFUNCTION INVESTIGATION STAFF

#### 6.1 GENERAL

The Malfunction Investigation Staff (MIS) is composed of three main laboratories: (1) Electronics Laboratory, (2) Metallurgical Laboratory, and (3) Mechanical Systems and Fluids Laboratory.

#### 6.2 ELECTRONICS LABORATORY

Location: O&C Building, M7-355 (see Figure A-1), Rooms 1233 and 2259

Area: 4,132 Square Feet, Total

Function: Measure and record basic parameters in electrical systems to confirm, isolate, and identify the basic failure mechanisms and the initial cause of failure.

Examine and evaluate systems, circuits, and components as to their design, application, and manufacturing techniques.

Dissect subsystems and modules, as necessary, to determine the initial point of failure. Section individual components, if necessary, to determine failure mechanism and its cause, e.g., section and incrementally polish through any suspect area of a semiconductor or micro-circuit.

Prepare optical micrographs, scanning electron micrographs, and infrared micrographs of semiconductors junctions, as required, to isolate and identify basic failure mechanisms.

Measure any or all network parameters, e.g., phase, gain, attenuation, impedance, return loss, reflection coefficients, S parameters, etc. as required, for components and circuits, over the frequency range to 12.4 GHz.

Equipment: Broad selection of high-quality test instrumentation such as oscilloscopes, signal sources, recording equipment, etc., a variety of power supplies such as dc up to 250 amperes and variable voltage and frequency ac up to 2 kVA, sectioning and dissecting equipment, infrared microscopes, etc.



### 6.3 METALLURGICAL LABORATORY

Location: O&C Building, M7-355, Room 2211

Area: 1,539 Square Feet

Function: Perform metallographic analyses such as the study of fracture surfaces by means of low and high power light optics and high and ultrahigh magnifying microscopes in an endeavor to pinpoint failure origins.

Perform hardness and microhardness determinations to aid in identifying improper heat treatment and adverse phase changes within the microstructure.

Make recommendations on protective coatings, platings, design and/or material changes, etc. for function, safety, and economic considerations.

Equipment: Metallographs, microscopes, hardness testers, polishers, etcher, heat-treating furnaces, lapping wheels, cleaners, etc.

### 6.4 MECHANICAL SYSTEMS AND FLUIDS LABORATORY

Location: O&C Building, M7-355, Rooms 1237 and 2275

Area: 2,201 Square Feet, Total

Function: Perform malfunction investigative work on all KSC mechanical and electromechanical pneumatic and hydraulic fluid flow problems. Every attempt is made to determine, isolate, and evaluate the primary step in any problem causality train so that the most basic problem area causes may be isolated and identified.

Perform visual and radiographic examinations, nondestructive failure verification and functional testing, and environmental and chemical tests, as required.

Review results and formulate investigative procedures, determining and implementing the optimum approach.

Equipment: Pneumatic and hydraulic consoles, metrology instruments, infrared scanner, photo equipment, dissection/disassembly equipment, laminar clean flow benches, etc.

## SECTION VII

### DEVELOPMENT TESTING LABORATORIES

#### 7.1 GENERAL

The Development Testing Laboratories are functional laboratories within the Development Testing Branch, SO-LAB-1, which provide an in-house prototype testing and fabrication capability to permit the development of engineering designs and requirements within a test environment. Participation by the design and/or operational engineer throughout the development and testing of his project is welcomed and encouraged by the Development Testing Laboratories. The objective in the support of existing facilities is the improvement and validation of modification packages through standard industry practices of investigating ideas through the use of prototypes, models, breadboards and mock-ups. In the support of new requirements, the Branch is engaged in the development and/or verification of design concepts through functional testing of prototypes and mock-ups. Utilization of this support by both the design and operational elements of the Center also results in continuous upgrading of design capabilities through practical application of state-of-the-art theory and knowledge.

The Development Testing Laboratories are composed of four functional units: (1) Mechanical Unit, (2) Functional Test Unit, (3) Electrical/Electronic Unit, and (4) Instrumentation Unit.

#### 7.2 MECHANICAL UNIT LABORATORIES

The Mechanical Unit Laboratories are subdivided into the Metalworking Laboratory, Metalforming and Welding Laboratory, and Woodworking Laboratory.

##### 7.2.1 METALWORKING LABORATORY

Location: Fluid Test Support Building, M7-1061, Rooms 108 and 112  
(See Figure A-1)

Area: 495 Square Feet, Total

Function: Precision machining of small to medium size components.

Equipment: Vertical milling machine incorporating the use of optical tooling, 10-inch toolmakers lathe, metal shaper, grinders of various types, metal sawing equipment, etc.

##### 7.2.2 METALFORMING AND WELDING LABORATORY

Location: Building M7-1061, Room 116

Area: 629 Square Feet

Function: Precision shearing, breaking, and punching of material up to 1/4 inch thick by 6 feet in length.

Precision brazing, burning, resistance arc (ac and dc) and shielded arc (ac and dc heliarc) welding of standard steels, aluminum alloys, stainless steels, and exotic materials.

Metal spraying, using various metals (including tungsten) to build up shafts, resurface, etc.

Equipment: Press brakes, drill presses, bench saws, riveters, welding machines, shears, rollers, milling machines, sanders, microscopes, hand tools, electronic test instruments, etc.

### 7.2.3 WOODWORKING LABORATORY

Location: Building M7-1061, Room 114

Area: 625 Square Feet

Function: Fabricate precision wooden engineering models and mock-ups of various shapes and sizes.

Equipment: Table, jig, and band saws, lathe, shaper, jointer, etc.

## 7.3 FUNCTIONAL UNIT LABORATORIES

The Functional Unit Laboratories provide facilities for cleaning and performing functional tests and analyses on components undergoing development and evaluation. The laboratories consist of: (1) the Disassembly Laboratory, (2) a Clean Room, (3) the Functional Testing Laboratory, and (4) the Component Readiness Laboratory.

### 7.3.1 DISASSEMBLY LABORATORY

Location: Building M7-1061, Room 107

Area: 415 Square Feet

Function: Serves as a preparatory area for components entering the Clean Room.

Equipment: Tools and equipment necessary for performing the required disassembly and preparatory operations.

### 7.3.2 CLEAN ROOM

Location: Building M7-1061, Room 105

Area: 790 Square Feet

Function: Functional testing of cleaned components undergoing further development and evaluation.  
Chemical cleaning of small components.  
Perform particulate, gravimetric (non-volatile residue), and aerosol analysis.

Equipment: Equipment for providing a Class 100 vertical flow clean area, chemical cleaning, analysis, test, etc.

#### 7.3.3 COMPONENT READINESS LABORATORY

Location: Building M7-1061, Room 101

Area: 540 Square Feet

Function: Provides a fabrication and assembly area in support of the Functional Testing Laboratory.  
Assemble prototypes and/or mock-ups too large for the performing laboratory.

Equipment: Magnetic tape recorders, strip chart recorders, pressure and temperature transducers, oscilloscopes, voltage calibration units, telemetry instrumentation, etc.

#### 7.4 ELECTRICAL AND ELECTRONIC UNIT LABORATORIES

These laboratories consist of the Electrical/Electronic Laboratory and the Potting and Molding Laboratory.

##### 7.4.1 ELECTRICAL/ELECTRONIC LABORATORY

Location: Building M7-1061, Rooms 102 and 104

Area: 820 Square Feet, Total

Function: Development of improved techniques for fabrication of cables, printed circuit boards, and the like.  
Mechanical buildup and wiring of electrical and/or electronic instruments.

Equipment: Cable fabricating equipment, photo equipment, etching tanks, various items of machinery, tools, etc.

##### 7.4.2 POTTING AND MOLDING LABORATORY

Location: Trailer No. 229

Area: 400 Square Feet

Function: Investigate unique applications for various types of potting and molding compounds.

Equipment: Potting and molding equipment, testing and measuring devices, hand tools, etc.

7.5 INSTRUMENTATION UNIT LABORATORY

Location: Building M7-1061, Room 106

Area: 285 Square Feet

Function: Perform buildup and repair of measuring equipment.

Equipment: Standard electrical and electronic laboratory test instruments, hand tools, etc.

## SECTION VIII

### COMPONENT CLEANING AND TESTING LABORATORIES

#### 8.1 GENERAL

The Component Cleaning and Testing Laboratories provide the following services: (1) component cleaning and testing, (2) hypergolic decontamination (components), (3) in-place cleaning and testing, (4) in-place hypergolic decontamination, (5) hydrogen peroxide passivation, and (6) vessel and hose cleaning. Functionally, these services consist of hypergolic decontamination, hydrogen peroxide passivation, refurbishment, cleaning, and testing of components and systems.

Hypergolic decontamination involves the chemical neutralization or solvent flushing, as required, of hypergolic fuel or oxidizer contaminated components and systems.

Hydrogen peroxide passivation is performed on items prior to their being put into hydrogen peroxide service. Stringent mechanical and/or chemical cleaning processes followed by a peroxide conditioning are used to accomplish this treatment. Each component or system is tested after the passivation process to insure its suitability for use.

Refurbishment involves replacement of component soft goods and defective hard goods, and minor rework such as lapping valve seats, chasing threads, etc. System refurbishment consists of removal and refurbishment of system components, and installation of new gaskets or other seals.

Cleaning includes mechanical, ultrasonic, and chemical processes to remove gross contamination with final cleaning of components being accomplished in an environmentally controlled area (clean room) using solvents. System cleaning is accomplished in-place by flushing or spraying chemicals and solvents. Analysis of the final solvent flush solution is performed to insure compliance with specification requirements.

Testing includes hydrostatic proof testing, cleanliness testing, functional and leak testing (utilizing hydraulics, pneumatics, and cryogenics), electrical resistance and continuity testing, valve timing, and filter element bubble point testing.

Certification of conformance with applicable specifications is provided for all items processed by the laboratories, and packaging is provided to preserve the cleanliness of the item.

These services are performed in buildings in the Complex 39 area and the Cape Canaveral Air Force Station (CCAFS), providing a total work area of 13,000 square feet.

## 8.2 COMPONENT CLEANING AND TESTING SERVICE

Location: LC-39, Building K7-516 (See Figure A-2), Rooms 118, 119, 120, 122, and 125 through 128

Area: 6,000 Square Feet, Total

Function: Testing the structural integrity of components and assemblies to one and one-half times the designed operating pressure.

Disassembly, inspection for anomalies, and restoration of components and assemblies to meet configuration requirements.

Chemical and mechanical treatment of components, materials, and assemblies to remove gross contaminants, i.e., rust, weld, slag, etc., and treatment (passivation) to prevent corrosion.

Removal of atmospheric and residual contaminants, validation of cleanliness to specification requirements through flushing (ultrasonics, if required) of component parts with solvents and microscopic particulate, and non-volatile residue analysis of the effluent flush liquid to certify conformance with applicable cleanliness specification requirements.

Reassembly and functional testing (electrically, pneumatically, hydraulically, or cryogenically) of components to meet design/operational requirements.

Installation of cleanliness preservation media, i.e., plastic overwrap to prevent moisture permeation, etc.

Equipment: Fixed and mobile handling equipment, vapor degreasers, ultrasonic cleaners, laminar flow clean benches, hydraulic test console, etc.

## 8.3 HYPERGOLIC DECONTAMINATION (COMPONENTS)

Location: LC-39, Building K7-417

Area: 1,000 Square Feet

Function: Decontamination of valves, vessels, cylinders, flex hoses, regulators, filters, panels, etc. from LC-39 hypergolic systems.

Equipment: Air removal system, rinse sink, neutralizer tank, emergency breathing equipment, waste chemical holding tank, work benches, hand tools, and gaseous nitrogen and demineralized water storage and distribution systems.

#### 8.4 IN-PLACE CLEANING, TESTING, HYPERGOLIC DECONTAMINATION, AND VESSEL AND HOSE CLEANING

Location: LC-39, Building K7-563, and at various locations throughout KSC and CCAFS.

Area: 5,000 Square Feet, under-roof of Building K7-563

Function: Testing structural integrity of system by hydrostatically pressuring system with appropriate fluid.

Refurbish functional components to design specifications.

Removal of accumulated contamination by means of chemical, solvent, or mechanical techniques.

Functional testing of system components to insure operational readiness.

Removal of hypergolic propellants from GSE systems.

Certifying that systems are decontaminated.

Chemical treatment of vessels or hoses to remove gross contamination.

Validation of cleanliness by flushing or spraying critical surfaces of the vessels or hoses with solvent and analyzing the effluent flush solvent to assure that the particulate and non-volatile residue levels meet specification requirements.

Determination of vessel or hose structural integrity by hydrostatically pressurizing them to one and one-half times the design operating pressure, inspecting for anomalies while pressurized.

Equipment: Mobile chemical tankers (8,000 gallon) with tractor, centrifugal pumps, mobile high-pressure units (3,000 psig and 6,000 psig), storage tanks, mobile analytical laboratories, solvent circulating system, hypergolic decontamination consoles, hydrostatic testing pumps, automatic boiler, vats, hose tower, etc.

#### 8.5 HYDROGEN PEROXIDE PASSIVATION

Location: CCAFS, Building 6-1051 (See Figure A-3)

Area: 1,000 Square Feet



Function: Disassembly, inspection, and restoration of component parts to the proper configuration.

Treatment of component parts to make them passive to hydrogen peroxide.

Acceptance testing of components to assure that the particulate size and population level meets specification requirements, and that the passivity level meets specification requirements when the components are exposed to hydrogen peroxide.

Equipment: Nitric acid tanks and hydrogen peroxide sinks with drainage disposal system, safety showers and eyewash fountains, laminar flow bench, ultrasonic unit, analytical apparatus, etc.

## SECTION IX

### CHEMICAL SAMPLING AND ANALYSIS LABORATORY

#### 9.1 GENERAL

The functions of this Laboratory consist of sampling and analysis of GSE and Flight Systems gases, propellants, coolants, and environments to determine specification conformance; analysis of solvents and solutions related to systems cleaning to determine purity, cleanliness, and contamination levels; and chemical sampling and analysis of ground water/discharge and air pollutants related to the Environmental Protection Agency requirements. A variety of instrumentation and apparatus peculiar to an analytical laboratory is utilized to perform the work of these functions.

#### 9.2 FLUID SAMPLING

Location: LC-39, Building K7-516 (See Figure A-2), Room 101A

Area: 1,000 Square Feet

Function: Procurement acceptance of fluids purchased by KSC.

Validation of:

- Fluids stored in KSC equipment
- Fluid purity in system lines
- Fluids during transfer at interface points
- Fluids loaded into flight hardware
- Support fluids for a variety of uses including maintenance, facility control, etc.

Equipment: Millipore filter holders, high pressure Hoke stainless steel cylinders, vacuum sources, psychrometers, samplers, pressure reducing panels, etc.

#### 9.3 SPECIFICATION CONFORMANCE ANALYSES AND RESIDUAL GAS ANALYSIS

Location: LC-39, Building K7-516, Rooms 108 through 116 and 120

Area: 4,500 Square Feet, Total

Function: Analyzing various gaseous fluid samples for contaminant levels, determining purity of the gases, and comparing the values obtained with allowable levels referenced in the specification for the gas being tested.

Analyzing various liquid samples for particulate and chemical contaminants and then comparing the contamination levels found with those referenced in the applicable specifications.

Performing analyses directly on system fluids at the system location. These analyses are normally made to determine system condition rather than conformance to a complete fluid specification.

Performing analyses on faulty environments to assure that the facility is adequate for performing its designed function, i.e., checks on air cleanliness and air conditioning parameters. Analyses are also performed on the environmental air to assure that toxic materials are not present in concentrations which would affect the health or safety of personnel.

Monitoring of the altitude chambers to detect residual gases and foreign gases entering the chamber.

Identifying and qualifying the gases present in the annular space of cryogenic equipment.

Equipment: Spectrophotometers (atomic, infrared, and ultraviolet), gas chromatographic systems, analyzers, pH meters, microscopes, mass spectrometers, etc.

#### 9.4 TITANIUM COMPATIBILITY TESTING SERVICE

Location: LC-39, Building K7-417 (See Figure A-2

Area: 100 Square Feet - plus some chemical hood space shared with other laboratory functions in Building K7-516.

Function: Expose spacecraft propellant tank material to hypergolic fuels and oxidizers.

Stress loading of fuel strips being tested.

Stress loading of oxidizer strips being tested.

Equipment: Exposure cells, load frames, environmentally controlled enclosures, reverse cycle heat pumps, fume hoods, standard weights, leveling jacks, drip pans. etc.

## SECTION X

### NONDESTRUCTIVE EVALUATION LABORATORY

#### 10.1 GENERAL

This Laboratory provides nondestructive investigation (NDI) support for KSC and the CCAFS, serving as the prime NDI information gathering source in support of groups conducting component verification, engineering studies, and malfunction analyses. The Laboratory is organized/equipped to provide both in-lab and on-site (field) support. Investigative capability includes radiography (x-ray and gamma), ultrasonics, eddy current, magnetic particle, dye penetrants, high voltage spark, and leak detection (mass spectrometry, thermal conductivity, and ultrasonics).

#### 10.2 NDI

Location:	LC-39, Building K7-569-1 (See Figure A-2), Buildings 77375 and 77380 (See Figure A-3), and on-site with portable equipment.
Area:	Building K7-569-1      1,000 Square Feet Buildings 77375 and 77380      5,000 Square Feet
Function:	Determination of component orientation inside sealed containers, included/excluded materials in sealed components, and bonding integrity in brazed/welded joints, potted components, sandwich composites (honeycomb), etc.  Detection and analysis of material defects.  Conformance analysis of materials to specification requirements in the areas of thickness measurement and segregation and identification of materials.  Integrity evaluation of solid propellant motors in the CCAFS Betatron facility.
Equipment:	X-ray generation instruments, radioactive isotope units, film densitometers, zygo unit, high voltage spark testing equipment, etc.

#### 10.3 LEAK DETECTION

Location:	LC-39, Building K7-569-4, and various KSC and CCAFS on-site locations.
Area:	600 Square Feet (K7-569-4)

Function: Transporting of equipment to and from the on-site leak detection locations, and setup and calibration of the equipment.

Leak testing of mission-critical flight hardware and ground support equipment to determine fluid medium transfer or leakage across separating boundaries. The data obtained by these tests are used to verify integrity of launch vehicles, spacecraft, and supporting systems from a fluid leakage standpoint.

Equipment: Mass spectrometers, ultrasonic translators, thermal conductivity indicators, capillary leak standards, roughing pumps, etc.

## SECTION XI

### MICRO CHEMICAL ANALYSIS LABORATORY

#### 11.1 GENERAL

The Micro Chemical Analysis Laboratory consists of the Wet Chemical Laboratory and Instrumental Analysis Laboratories. This Laboratory provides the facilities to perform sophisticated as well as standard chemical tests, sampling, certification, validation and analytical investigations. Some of the disciplines pursued by this Laboratory are Malfunction Investigation, Material Acceptance Analyses, Non-routine Analysis, Methods Development and Specialized Analysis, and Chemical Research and Development.

An extensive collection of standard certified samples (particularly alloys) from the National Bureau of Standards, British Bureau of Analyzed Samples, and other sources are maintained in addition to well over 1,000 different chemicals that are suitable for use as uncertified standards. Efforts are constantly under way to provide good secondary standards by analysis and checking of commercially available alloys, for which primary standards are not available.

#### 11.2 WET CHEMICAL LABORATORY

Location: O&C Building M7-355 (See Figure A-1)

Area: 625 Square Feet

Function: Perform the following:

- Handling, synthesis, purification, and analysis of materials ranging from hypergolic propellants to small quantities of explosives and highly toxic chemicals.
- Conductometric, potentiometric, and colorimetric titrations
- Atomic absorption spectrophotometry
- Flame emission spectroscopy
- Polarographic Analysis
- C, H, N determination
- Ultraviolet-visible-near infrared spectrophotometry
- Electrodeposition

- Detection of carbon and sulfur in metals
- Purification and separation by techniques such as distillation, extraction, and thin layer chromatography

Equipment: Apparatus for most classical methods of analysis

### 11.3 INSTRUMENTAL ANALYSIS LABORATORIES

The Instrumental Analysis Laboratories are comprised of the Infrared Spectroscopy Laboratory, X-Ray Diffraction/Fluorescence Laboratory, Thermal Analysis Laboratory, Gas Chromatography Laboratory, Emission Spectroscopy Laboratory, Mass Spectrometry Laboratory, Electron Microscopy Laboratory, Electron Microprobe X-Ray Analysis Laboratory, and Induced Electron Emission Spectrometry Laboratory.

#### 11.3.1 INFRARED SPECTROSCOPY LABORATORY

Location: O&C Building, Room 1268

Area: 425 Square Feet

Function: Determination of material identify, quality, conformity to specifications, and characteristics

Equipment: Spectrophotometers (including 4X beam condenser), Fourier transform spectrometer, interferometer, etc.

#### 11.3.2 X-RAY DIFFRACTION/FLUORESCENCE LABORATORY

Location: O&C Building, M7-355, Room 1270

Area: 250 Square Feet

Function: Analyze materials, components, etc. by means of x-ray and fluorescence equipment.

Equipment: Spectrograph, diffraction generators, diffraction cameras, etc.

#### 11.3.3 THERMAL ANALYSIS LABORATORY

Location: O&C Building, M7-355, Room 1270

Area: 125 Square Feet

Function: Perform off-gas analysis.

Perform transition temperature and energy measurements from -100°C to +500°C.

Record differential changes in weight and temperature of a sample while sample temperature is varied from room temperature to 3,000°F.

Equipment: Mettler thermal analyzer, differential scanning colorimeter, environmental chamber, etc.

#### 11.3.4 GAS CHROMATOGRAPHY LABORATORY

Location: O&C Building, M7-355, Room 1268

Area: 200 Square Feet

Function: Perform analytical and preparative chromatography.

Equipment: Chromatographs, various detectors, etc.

#### 11.3.5 EMISSION SPECTROSCOPY LABORATORY

Location: O&C Building, M7-355, Room 1269A

Area: 500 Square Feet

Function: Produce and analyze various types and characteristics of emissions.

Equipment: Spectrographs, recording densitometer, etc.

#### 11.3.6 MASS SPECTROMETRY LABORATORY

Location: O&C Building, M7-355, Room 1269

Area: 500 Square Feet

Function: Provide mass spectrometry analysis utilizing direct introduction systems for solid samples as well as conventional inlet systems. Solids changing sources can also be handled.

Equipment: C.E.C. Model 104 mass spectrometer with gas chromatograph interface, and a C.E.C. Model 110 double focusing mass spectrometer which can be converted to an RF spark source instrument.

#### 11.3.7 ELECTRON MICROSCOPY LABORATORY

Location: O&C Building, M7-355, Rooms 1269C and 1273

Area: 200 Square Feet, Total



Function: Provide finite analysis capability utilizing magnification and diffraction techniques.

Equipment: Electron microscope with direct magnification capability to 300,000X, photographic equipment to increase magnifications to 1,500,000X and provide high resolution electron diffraction and stereophotography, and a scanning electron microscope equipped with an EDAX x-ray analyzer system which allows high resolution electron micrography and elemental analysis of the sample to be made at the same time.

#### 11.3.8 ELECTRON MICROPROBE X-RAY ANALYSIS LABORATORY

Location: O&C Building, M7-355, Room 1269B

Area: 250 Square Feet

Function: Perform x-ray analysis utilizing a specialized electron microprobe x-ray analyzer.

Equipment: Applied Research Laboratories Model EMX Electron Microprobe X-ray analyzer equipped with two pulse height analyzers, three scalars, a four-channel recorder, two oscilloscopes, and a magnetic sweep drive.

#### 11.3.9 INDUCED ELECTRON EMISSION SPECTROMETRY LABORATORY

Location: O&C Building, M7-355, Room 1270

Area: 125 Square Feet

Function: Provide electron spectroscopy for chemical analysis. Elemental analysis of the first few atomic layers of a surface may be obtained in less than 3 hours. The spectra obtained gives information about the chemical state of an element as well as its identity. With proper standards, this technique may be used for quantitative analysis.

Equipment: Varian IEE-15 Induced Electron Emission Spectrometer

## SECTION XII

### MATERIALS TESTING LABORATORIES

#### 12.1 GENERAL

The Materials Testing Laboratories are functional laboratories which provide for the evaluation of equipment and materials utilized at KSC. These Laboratories consist of the Metallurgical Testing Laboratory, Plastics and Elastomers Testing Laboratory, Coatings Evaluation Laboratory, Lubricant Testing Laboratory, LOX Testing Laboratory, and Environmental Testing Laboratory. Typical equipment includes that used for the spacecraft and GSE components and systems.

In addition to the equipment and systems listed subsequently in the Equipment paragraph for each Laboratory there are several items of support equipment available to all of the Materials Testing Laboratories, such as: Bridgport milling machine, band saw, abrasive cutoff wheel, drill press, tube flaring machine, belt sander, punch and arbor presses, and torque-tension tester.

Materials tested include plastics, elastomers, coatings, ferrous and non-ferrous metals, lubricants, and composites. The technical areas of support provided also include electronics, oxygen compatibility, environmental testing, and exposure testing (performed at a beach site).

#### 12.2 METALLURGICAL TESTING LABORATORY

Location: O&C Building, M7-355, Room 1219 (See Figure A-1)

Area: 1,000 Square Feet

Function: Perform strength, toughness, and hardness tests on metals and alloys.

Perform metallurgical analysis to determine microstructural features of metals and alloys, including the effects of various heat treatments, the presence and distribution of non-metallic inclusions, and deterioration associated with corrosion phenomena.

Determine electrical properties and parameters of devices and systems under various environmental conditions.

Perform experimentation involving studies of chronological changes in the discrete parameters of semiconductors, integrated circuits, and various electronic devices during environmental stress.

Equipment: Universal testing machine (120,000 pounds), impact tester, hardness testers, constant load stress-corrosion tester, arc resistance test equipment, dielectric strength tester, electrostatic charge tester, oscilloscopes, recorders, etc.

#### 12.3 PLASTICS AND ELASTOMERS TESTING LABORATORY

Location: O&C Building, M7-355, Room 1213

Area: 1,000 Square Feet

Function: Develop, formulate, and test various compositions of plastics and elastomers in support of flight and GSE.

Equipment: Universal testing machine, testers of various types, injection molding machine, mixing mill, extruder, laboratory press, etc.

#### 12.4 COATINGS EVALUATION LABORATORY

Location: Building M7-505 (See Figure A-1), Room 102

Area: 305 Square Feet

Function: Evaluation of various coatings applied to materials utilized at KSC on GSE. Usually, evaluation is performed by preparing the coating material and the substrate surface; applying the coating by spraying, dipping, or fluidized bed; determining the thickness, adherence, and abrasion resistance after curing; and assessing the protection afforded by the coating under conditions more severe than ordinary field conditions. In most instances, flat 4- by 6-inch panels or Tator panels are used and exposed at a fenced beach site approximately 50 yards from the ocean at KSC.

In other instances, the coating may be applied to items of hardware, and exposure may be performed in other locations such as communication cable man-holes or under controlled laboratory conditions.

Equipment: Sand blast cabinet, spray booth, fluidized bed coating equipment, paint shaker, paint mixer, pressure pot, spray guns, exposure frames and racks, scrape-adhesion tester, and permascope eddy current coating thickness indicator.

#### 12.5 LUBRICANT TESTING LABORATORY

Location: O&C Building, M7-355, Room 2283

Area: 500 Square Feet

Function: Characterize and evaluate lubricants for use at KSC. Lubricant characterization consists of the measurement of certain physical properties such as dropping point, penetration, evaporation, oxidation stability, and viscosity. Lubricant evaluation is the testing of a lubricant toward a specific application where corrosion protection, wear properties, and potential operational performance are determined.

Equipment: Viscosimeters, various testers (flash point, extreme pressure, wear, water washout, etc.), grease working machine and penetrometer, etc.

#### 12.6 LOX TESTING LABORATORY

Location: Building M7-1509 (See Figure A-1)

Area: 450 Square Feet

Function: Determine the compatibility of a wide variety of materials with liquid oxygen (LOX). The test method employed is based upon the tendency of materials to react with LOX on impact and is commonly known as the "ABMA Tester." An average of 50 test drops are generally performed daily on a variety of materials including lubricants, sealants and threading compounds, thermal and electrical insulations, elastomers, plastics, adhesives, gaskets and packing, metals, alloys, solders, dye penetrants, solvents, and cleaning solutions.

Equipment: The present laboratory consists of two test cells - a sample preparation area and an area for storage of cryogenic dewars and other necessary supplies. Test equipment includes a LOX impact tester, oxygen aging apparatus, vapor degreaser, drying oven, cryogenic dewars, cutting press and dies, and refrigerator.

#### 12.7 ENVIRONMENTAL TESTING LABORATORY

Location: O&C Building, M7-355, Room 1219

Area: 2,000 Square Feet

Function: Environmental testing is the simulation of conditions or combinations of conditions that an item will encounter prior to and during functioning. The Environmental Testing Laboratory provides dynamic and climate testing services. Dynamic testing includes vibration, shock, and acceleration. Climatic testing includes temperature, humidity, vacuum, pressure, salt spray, solar simulation, and rain. The total environmental test capability is available for standardized and special developmental and qualifying testing of components and systems.

Equipment: High-frequency vibration equipment, shock test equipment, high-temperature ovens, temperature-altitude and temperature-humidity chambers, vacuum systems, and salt spray chamber.

## SECTION XIII

### TECHNICAL SHOPS

#### 13.1 GENERAL

The primary purpose of the Technical Shops under the cognizance of the Support Operations Directorate (SO) is to provide immediate response to support NASA requirements. Technical Shops support is limited to requirements involved with the modification or fabrication of equipment associated with space vehicles, vehicle components, ground support equipment (GSE), or associated space vehicle systems.

The support services furnished are of a highly technical nature, requiring precision craftsmanship and strict adherence to NASA standards and specifications.

Services of these Shops are performed in NASA facilities at the John F. Kennedy Space Center (KSC) and the Cape Canaveral Air Force Station (CCAFS).

The facilities are located in five buildings identified as the Launch Equipment Shop (LES), Central Instrumentation Facility (CIF), Hangar "AF", Supply, Shipping, and Receiving, and Mechanical Operations Complex (MOC).

#### 13.2 MACHINE SHOP - LES

Location: LES, Building K6-1247 (see Figure A-2)

Area: 11,277 Square Feet

Function: This facility supports Launch Complex 39 activities; it also supports other shops when they are overloaded or have requirements for special machinery. This facility is a very modern and well equipped machine shop. Specialized machines are at this location to take advantage of the support items required for normal operation.

A brief outline of the work performed is as follows:

- Lathe Work. Capabilities extend from small precision toolmaker lathes with a 10-inch swing to a large 12-5/8-inch hollow spindle with a 65-inch swing through the bed gap.
- Milling. Capabilities extend from micromilled precision work to heavy slab milling with a bed size of 72 by 17 inches and equipped with lead attachment and other gear and speed variations.

- Grinding. Capabilities include cylindrical, internal, external, and surface grinding with full tool, cutter grinding, and spiral end taper precision grinding operations.
- Sheet Metal. Capabilities include the bending, braking, shearing, punching, and rolling of materials in thicknesses up to 1/2 inch and lengths up to 10 feet. Complete metal punching and precision duplicating facilities for panel fabrication are included.
- Welding. Extensive capabilities provide for the welding of various alloys of stainless, aluminum, brass, copper, bimetallic, and other metal compounds. Heat treating and dry vacuum sand blasting are also available. An induction brazing unit contained in a mobile trailer offers versatility and is capable of brazing tubing sizes 1/4 inch to 2 inches inclusive with wall thicknesses ranging from 0.035 to 0.109 inch.
- Painting. A position pressurized spray booth and joining drying oven offer an unlimited painting capability to meet NASA and Federal specifications.
- Engraving. Capabilities include engraving panels, nomenclature tags, and a wide variety of other engraving functions.

Equipment: In addition to the equipment indicated in the preceding (Function) paragraph, numerous other items of equipment such as band and cut-off saws, drill presses, punch presses, filing machines, layout machine, etc. are contained in this shop.

### 13.3 MACHINE SHOP - CIF

Location: CIF, Building M6-342 (see Figure A-1)

Area: 1,245 Square Feet

Function: Provide limited on-site support to CIF operations which include grinding, machining, milling, braking, and sheet metal fabrication, as follows:

- Lathe Work. One machinist lathe is available having a 14-inch swing and a distance between centers of 30 inches.
- Milling. One variable speed milling machine capable of half tolerance machine standards is available. This machine has a table size of 12 by 48 inches.

- Grinding. Operations in this area are limited to surface grinding. The machine that is available has a table size of 13 by 6 inches and can accommodate stock up to 9 inches thick.
- Sheet Metal. Operations that can be accomplished in this area include bending, braking, shearing, punching, and drilling. In general, most sheet metal fabrication tasks can be performed. Shearing operations can be performed on mild steel up to 3/16 inch thickness by 48-inch length. A precision layout machine is available which can accept material up to 18 by 24 inches.

Equipment: Other equipment in addition to the equipment indicated in the preceding (Function) paragraph includes band and table saws, arbor press, notcher, etc.

#### 13.4 ELECTRIC SHOP - LES

Location: LES, Building K6-1247

Area: 3,946 Square Feet

Function: Fabricate electrical associated systems and their interconnecting accessories in support of space vehicle operations.

Fabricate, assemble, and checkout power and instrumentation cables, harnesses, distributor systems, etc.

Repair, service, install, and checkout electrical systems associated with space vehicles, and all types of system interconnects.

Environmental encapsulation of harness and cable connectors and fabricated assemblies.

Equipment: Viscosity meter, subzero storage cabinets, weighing scales, vacuum mixing pumps, ovens, drill press, labeling machine, etc.

#### 13.5 ELECTRONICS SHOP

Location: Building K6-1896 (see Figure A-2)

Area: 4,0005 Square Feet

Function: In support of space vehicle launches, the following work is performed.



- Fabrication. This area of the Electronics Shop is equipped to perform the assembly, modification, fabrication, and repair of manufactured electronic units and assemblies. A laboratory unit is available for the fabrication of printed circuit boards. This unit consists of tanks and associated equipment of printing, developing, etching, gold and silver plating, and cleaning of printed circuit boards. There is a high speed machine drill, eyelet equipment, and a curing oven capable of temperatures up to 550° F also available for use in the fabrication of printed circuit boards. Complete assembly and wiring of panels, chassis, printed circuit boards, consoles, patch panels, and checkout circuitry are also performed while maintaining rigid quality standards.
- Inspection and Testing. Test equipment such as oscilloscopes, sweep generators, insulation and tube tester, regulated power supplies, oscillators, and differential and vacuum tube voltmeters is available to the technicians for testing and inspections. Also some special equipment such as an electron meter for making solution checks, a 7 to 30 power stereo microscope for checking for flaws in printed circuit boards, and a trace recording camera is available.
- Drafting. The preparation of master artwork as used in the development of printed circuit boards, schematics, and wiring diagrams is performed in this Shop. Drawings applicable to the fabrication of chassis and related components are also prepared.
- Additional Services. Mobile electronic induction brazing facilities are available. Also, electronic facilities technical services are available. Also, electronic facilities technical services are available for the checkout, repair, maintenance, and functional testing of electronic equipment.

Equipment: The operations and the equipment mentioned in the preceding (Function) paragraph provide a general concept of the equipment contained in this shop.

### 13.6 MECHANICAL FABRICATION SHOP - HANGAR AF

Location: CCAFS, Hangar AF (see Figure A-3)

Area: 6,104 Square Feet

Function: Fabrication of pneumatic service lines and control panels, high pressure flexhoses, field service support, and refurbishment services.

Equipment: Two 40-ton overhead cranes, swagers, cutoff saws, flaring machines, tube benders, hydraulic systems test stand, etc.

13.7

MECHANICAL OPERATIONS COMPLEX

Location: MOC, Building K6-1996-D (see Figure A-2)

Area: 3,707 Square Feet

Function: Perform field modifications on the mobile launchers, mobile service structure, service structures, flight crew training equipment, etc.

Provide maintenance service on machinery and equipment, both in the shop and in the field.

Equipment: Drill presses, band saw, honer, compressor, pipe threader, electric generator, etc.

## SECTION XIV

### INSTRUMENTATION SYSTEMS LABORATORIES

#### 14.1 GENERAL

These laboratories provide measuring systems for vehicle and ground measurements, RF and telemetry laboratories, and telemetry checkout equipment (TCE) for on-board telemetry equipment. Some space is allocated for storage of equipment and spares.

#### 14.2 MEASURING SYSTEMS LABORATORIES

The Measuring Systems Laboratories are subdivided into the Vehicle Measuring Laboratory and the Ground Measuring Laboratory.

##### 14.2.1 VEHICLE MEASURING LABORATORY

Location: VAB (see Figure A-2) Rooms 5E17, 15E21, 22E19, 27E7, 27E13, and 27E15.

Area: 8,550 Square Feet, Total

Function: Scheduled preventive maintenance of vehicle measuring GSE, stage measuring systems, failure verification of removed stage hardware, and pre-installation checkout of replacements.

Equipment: Digital receiving stations, digital to analog converters, patch panels, recorders, digital printers, digital voltmeters, and module test sets.

##### 14.2.2 GROUND MEASURING LABORATORY

Location: Launch Control Complex (LCC), Rooms 2P10D and 2P25

Area: 1,477 Square Feet, Total

Function: Check out of Digital Data Acquisition Systems (DDAS) and telemetry and LCC Measuring Station equipment.

Calibrate transducers, checkout measuring amplifiers and repair of measuring recorders.

Equipment: Digital recording devices, oscilloscopes, meters, and other equipment for repair testing, calibration, and troubleshooting.

### 14.3 RADIO FREQUENCY AND TELEMETRY LABORATORIES

These laboratories are subdivided into the Radio Frequency Laboratory, LCC TCE, LCC TCE Laboratory, and contractor laboratories.

#### 14.3.1 RADIO FREQUENCY LABORATORY

Location: VAB, Rooms 2P10, 26B7, and 26E7

Area: 2,688 Square Feet, Total

Function: Checkout and make ready for launch the Command and Communication System (CCS) and the Radar Beacon System.

Functionally test and analyze the CCS's capability to:  
(1) range (pseudo random ranging techniques employed),  
(2) interface with ground equipment for uplinking commands to the Launch Vehicle Digital Computer (LVDC), and (3) provide a telemetry downlink to ground stations. The CCS's uplink frequency is 2101.8 MHz and downlink frequency is 228.5 MHz.

Functionally test and analyze the Radar Beacon Systems' capability to perform its function. The beacon's uplink frequency is 5690 MHz and its downlink frequency is 5765 MHz.

Functionally test and analyze the Instrumentation Unit Updata Command System (IUCS) which has an uplink frequency of 450 MHz.

Functionally test and analyze the Digital Range Safety Command System (DRSCS) which has a command frequency of 450 MHz. This frequency is used to shut down, destruct, and safe the launch vehicle.

Subject DRSCS components to environmental chamber conditions to requalify them at their temperature extremes.

Equipment: Radar Beacon checkout equipment, CCS checkout equipment, IUCS checkout equipment, DRSCS checkout equipment, cables, waveguides, antennas, etc.

#### 14.3.2 LCC TELEMETRY CHECKOUT EQUIPMENT (TCE)

Location: LCC, Room 2P10A

Area: 2,380 Square Feet

Function: Checkout of telemetry systems located on launch vehicles, pulse-code modulated hardwire telemetry signals routed from points on the complex, three basic types of telemetry data transmission utilized on the vehicle.

Simultaneously monitor two vehicle checkouts--may use open or closed loop operation, depending on patching setup.

Provide down converted RF signal for transmission to the CIF (closed loop operation).

Perform initial setup of vehicle telemetry systems, checkout spare package.

Perform detailed troubleshooting and fast response data reduction.

Check RF power and carrier frequency levels, single-side band (SS)/frequency modulation (FM) channel frequencies and amplitudes, pulse code modulation (PCM) format, and telemetry data continuity.

Equipment: Stage modules, common support equipment module, roof antennas and associated preamplifiers, CIF Interface equipment module, etc.

#### 14.3.3 LCC TCE LABORATORY

Location: LCC, Room 2P10C

Area: 1,050 Square Feet

Function: Provides storage area for all commercial test equipment used for maintenance and troubleshooting of TCE not in KSC calibration cycle.

Provides working area for maintenance mod kit installation, and vehicle telemetry problem analysis.

Equipment: Work bench, power supplies, tools, etc.

#### 14.3.4 LCC CONTRACTOR LABORATORY

Location: LCC, Room 2P23

Area: 794 Square Feet

Function: Provides area for storage of equipment, bench checks, troubleshooting, maintenance, kit installation, etc.

Equipment: Work benches, power supplies, tools, etc.

## SECTION XV

### ELECTRICAL, GUIDANCE, AND CONTROL SYSTEMS LABORATORIES

#### 15.1 GENERAL

These laboratories are located in the VAB, LCC and LC-39 areas to support on-line operations for testing and checkout of the Electrical, Guidance, Control and Navigation equipment for Apollo/Apollo-Soyuz Test Project ground and flight hardware. Component testing, evaluation, and fault isolation are performed in the laboratories for flight and ground hardware in conjunction with field engineering changes, and some maintenance activities.

#### 15.2 GYRO AND STABILIZER LABS

Location: VAB Low Bay, Rooms 1M6, 1M11, and 1M12 and LC-39 Automatic Azimuth Laying Theodolite (AALT) Buildings, J7-537 and J8-1858 (See Figure A-2)

Area: 3,318 Square Feet, Total

Function: Fabricate and repair electronic circuits, provide low-level clean rooms for gyro and theodolite calibration, perform alignment of inertial platforms.

Equipment: Compressed air, purging type gases, specialized test sets, optical alignment and calibration test stands, theodolite equipment and overhead cranes.

#### 15.3 GUIDANCE AND CONTROL SYSTEMS LABORATORIES

The Guidance and Control Systems Laboratories are comprised of five sublaboratories which provide facilities for the checkout of guidance and control systems and components, technique development, personnel training, and design of special equipment and devices.

##### 15.3.1 FLIGHT COMPUTER LABORATORY

Location: VAB, Room 1M10

Area: 1,130 Square Feet

Function: Checkout of Saturn Launch Vehicle Guidance Computer and Data Adapter. Repair and modify flight units.

Equipment: Special purpose computer and other specially built equipment as well as commercial equipment used for data storage, etc.

#### 15.3.2 FLIGHT CONTROL LABORATORY

Location: VAB, Room 1M7

Area: 918 Square Feet

Function: Perform inspection and testing on all Instrumentation Unit electronic and electro-mechanical components of the Saturn Flight Control System consisting of control accelerometers, control rate gyros, and flight control analog computer.

Equipment: Precision test equipment, specialized test consoles, special testing adapters, rate table, tilt table, and a large selection of commercial test equipment.

#### 15.3.3 GROUND COMPUTER LABORATORY

Location: VAB, Room 1D7

Area: 1,600 Square Feet

Function: Used for troubleshooting problems found with the RCA-110A Ground Computer during on-line Firing Room operations. Used for off-line compiling and development of Saturn software programs. Contains the Mobile Launcher Simulator for the ASTP Vehicle Launch Simulator System. Provides space and equipment for training in the state-of-the-art of new computer hardware, firmware, and software concepts.

Equipment: RCA-110A Computer and its associated peripheral gear, and some simulator equipment.

#### 15.3.4 GUIDANCE AND CONTROL (G&C) LABORATORY

Location: VAB, Room 3M5

Area: 465 Square Feet

Function: Train G&C personnel in latest electronic developments and techniques.

Equipment: Precision electronic equipment, equipment necessary for performing design and fabrication of electronic devices, etc.

#### 15.3.5 FLIGHT CONTROL LABORATORY

Location: VAB, Room 1M9

Area: 1,100 Square Feet

Function: Joint-use laboratory for several contractors used for receiving, inspection, testing, and servicing of hydraulic actuators.

Equipment: Overhead crains, hydraulic actuator jigs, test stands, holding fixtures, and length adjusting fixtures.

#### 15.4 ELECTRICAL SYSTEMS LABORATORIES

The Electrical Systems Laboratories are comprised of eight sublaboratories which provide facilities for training operations, and for maintenance and checkout of electrical components and systems.

##### 15.4.1 FLIGHT BATTERY LABORATORIES

Location: VAB, Rooms 25B17, 25E17, and 25B18

Area: 1,523 Square Feet, Total

Function: Perform activation and checkout operations on silver-zinc flight batteries.

Equipment: Large industrial refrigerators, flight battery test consoles, vacuum pumps, exhaust fans, etc.

##### 15.4.2 GROUND POWER LABORATORIES

Location: VAB, Rooms 5D3, 5D4, and 5D5

Area: 1,268 Square Feet, Total

Function: Perform maintenance and checkout of ground power supplies and backup battery systems.

Equipment: Power supply checkout consoles, test stations with contactors and shunts, 3-phase powerstats, etc.

##### 15.4.3 DIGITAL LABORATORY

Location: VAB, Room 5D7

Area: 411 Square Feet

Function: Provide breadboard facility for the Digital Events Evaluator computers used in the propellants system, and perform system training and run special support programs.

Equipment: Scientific Data Systems, computer teletype, 160-column line printer, and other associated equipment.



#### 15.4.4 COMPONENT TEST AREA LABORATORIES

Location: VAB, Rooms 22E11 and 22E13

Area: 948 Square Feet, Total

Function: Perform tests on relays, diodes, and circuit breakers.  
  
Checkout of propellant utilization electronics assembly and the static inverter used in the S-IVB propellant utilization system.

Equipment: Electronic test equipment and other equipment necessary for the performance of indicated tests.

#### 15.4.5 AUXILIARY PROPULSION SYSTEM LABORATORY

Location: VAB Low Bay, Room 1K15

Area: 2,602 Square Feet

Function: Electrically and mechanically checkout the auxiliary propulsion system modules used on the S-IVB stage.

Equipment: Electrical and mechanical equipment necessary for performing the various checks on the propulsion modules.

#### 15.4.6 TEST CONTROL CENTER LABORATORY

Location: VAB Low Bay, Room 3K8B

Area: 2,088 Square Feet

Function: Perform checkout of S-IVB power systems, electrical logic circuits, DDAS and instrumentation systems, complete J-2 engine electrical systems, hydraulic functions, propellant level monitor, and stage pressure.

Equipment: Electrical and mechanical equipment necessary for test and checkout of the systems indicated.

#### 15.4.7 FLEXIBLE AUTOMATIC CIRCUIT TESTER (FACT) LABORATORY

Location: VAB, Room 6E12

Area: 722 Square Feet

Function: Program and conduct wiring analyses of electrical harnesses and assemblies.

Detect continuity and leakage faults, pinpoint the nature and location of each fault, and record information on an IBM card.

Equipment: Printed circuit card tester, IBM card read machine, FACT, and associated equipment.

#### 15.4.8. ELECTRICAL SUPPORT LABORATORIES

Location: VAB, Rooms 5D6, 5D8, 5D9, 5D10, 5D11, 5D13, 7E6, 25E12, and LCC Room 4P3

Area: 4,016 Square Feet, Total

Function: Provide support for the maintenance and checkout of ground and flight electrical systems.

Equipment: Work benches, various test meters, oscilloscopes, signal generators, and other necessary equipment and tools.

## SECTION XVI

### MECHANICAL AND PROPULSION SYSTEMS, LABORATORY, SHOPS, AND ORGANIZATIONAL WORK AREA

#### 16.1 GENERAL

Laboratories, Shops, and Organizational Work Areas at LC-39 collectively provide facilities for: refurbishment of LC-39 mechanical GSE components; inspection, bench testing, adjustment, troubleshooting, and minor emergency repair of components at locations convenient to the launch vehicle or its associated GSE; and duty stations for technicians assigned to launch vehicle or associated GSE operations or maintenance.

#### 16.2 MECHANICAL SYSTEMS LABORATORY (MSL)

Location:	VAB (see Figure A-2) Low Bay, Rooms 1K1 thru 1K11, and 1L2 and 1L3	
Area:	● Disassembly, Reassembly, and Testing (Not a controlled environment)	4,720 Square Feet
	● Pneumatics Clean Room (Laminar flow, Class 10,000)	2,096 Square Feet
	● Hydraulics Clean Room (Laminar flow, Class 10,000)	1,295 Square Feet
	● Pneumatics Test Cell	160 Square Feet
	● Hydraulics Test Cell	145 Square Feet
	● Chemical Cleaning Area	615 Square Feet
	● Hydraulic Pump Room	180 Square Feet
	● Supply, Lockers, Office, and misc. areas	3,565 Square Feet
	Total	12,776 Square Feet

Function: To provide the capability to repair and recertify the mechanical GSE for which the contractor has operations and maintenance responsibility on LC-39 and, in special cases, to give shop support to other contractor organizations. The MSL capability includes: troubleshooting, disassembly, precision cleaning, cleanliness certification, inspection, reassembly, functional testing, and recertification. These operations can be performed within normal

environment shop areas or within a laminar flow clean room which meets the requirements of FED STD 209, Class 10,000. Operations requiring a higher cleanliness level can be performed on a clean bench. The MSL receives support from the Fluid Test Laboratory and from support shops which perform such operations as welding, machining, fabrication, chemical analyses, etc.

Equipment: One 15-ton overhead bridge crane, dead weight tester, degreaser, forklift, grinder, oscilloscope, lapping machine, drill press, etc.

### 16.3 FLUID TEST LABORATORY

Location: LC-39, VAB, Room MK-4

Area: 480 Square Feet

Function: To provide chemical, gas, or particulate analysis as required for determination of conformance to KSC-C-123(d) and other cleaning or cleanliness level specifications. Also, affords support for maintaining cleaning solutions, or some other fluids, within specifications.

Equipment: Vacuum pump, oven, evaporator, pH meter, spectrophotometer, Beckman analyzer, laminar flow test bench, etc.

### 16.4 ROOM 103, PAD TERMINAL CONNECTION ROOM (PTCR)

Location: LC-39, Pad A (in base of Pad), Building J8-1708  
(see Figure A-2)

LC-39, Pad B (in base of Pad), Building J7-337  
(see Figure A-2)

Area: 4,745 Square Feet, Pad A

4,745 Square Feet, Pad B

9,490 Square Feet, Total

Function: Used by various launch vehicle operations and maintenance contractors for elementary bench testing, adjustments, maintenance, and repair in support of GSE test and check-out operations. Not intended for precision repair of components and equipment requiring a clean environment. Serves as a duty station for some technicians at the Pad.

Equipment: Bench grinders, tube benders, drill press, and other equipment for making repairs, etc.

16.5 FUELS STORAGE AND TRANSFER SYSTEM MAINTENANCE SHOP

Location: LC-39, Pad A, Building J8-1614 (see Figure A-2)  
LC-39, Pad B, Building J7-243 (see Figure A-2)

Area: 1,273 Square Feet, Pad A  
1,225 Square Feet, Pad B  
2,498 Square Feet, Total

Function: Bench testing, adjustment, inspection, minor repair, and emergency refurbishment of components and equipment in support of operations, checkout, and maintenance of LH<sub>2</sub> and RP-1 systems. Serves as storage area for equipment used in field maintenance and as duty station for technicians at the Pad.

Equipment: Regulated pneumatic supplies, GN<sub>2</sub> and GHe (available from K bottles), pneumatic test panels, test gages, vacuum pumps, vacuum meters, gas analyzers, leak detectors, hand tools, drill press, bench grinder, vises, etc.

16.6 LOX STORAGE AND TRANSFER SYSTEM MAINTENANCE SHOP

Location: LC-39, Pad A, Building J8-1503 (see Figure A-2)  
LC-39, Pad B, Building J7-132 (see Figure A-2)

Area: 948 Square Feet, Pad A  
900 Square Feet, Pad B  
1,848 Square Feet, Total

Function: Bench testing, inspection, adjustment, minor repair, and emergency refurbishment of components and equipment in support of operations, checkout, and maintenance of the LOX systems. Serves as storage area for equipment used in field maintenance and as duty station for technicians at the Pad.

Equipment: Regulated pneumatics supplies, GN<sub>2</sub> and GHe (available from K bottles), pneumatics test panels, test gages, vacuum pumps, vacuum meters, gas analyzer, leak detectors, hand tools, drill press, bench grinder, vises, chain hoist, etc.

16.7 CONTRACTOR ORGANIZATIONAL WORK AREA

Location: LC-39, VAB, Room 5E7

Area: 6,000 Square Feet

Function: Serves as a duty station in the VAB for technicians assigned to checkout and maintenance of the launch vehicles and associated GSE for which the contractor has operations and maintenance responsibility. Provides a transient storage point for some hardware enroute to or from a mobile launcher.

Provides for elementary testing, repair, inspection, adjustment, and maintenance of components and equipment. Is not intended for complex repair or operations which require a cleanliness controlled environment or for pneumatics and hydraulics test setups.

Equipment: Drill presses, tube flaring machines, grinder, sander, work benches, metal saws, and shop air.

16.8 CONTRACTOR ORGANIZATIONAL WORK AREA

Location: LC-39, VAB, Room 5B6

Area: 6,000 Square Feet

Function: Serves as a duty station in the VAB for technicians assigned to checkout and maintenance of the launch vehicles and associated GSE for which the contractor has operations and maintenance responsibility. Provides a transient storage point for some hardware enroute to or from a mobile launcher.

Provides facilities for elementary testing, repair, inspection, adjustment, and maintenance of components and equipment. Is not intended for complex repair operations which require a cleanliness controlled environment.

Equipment: Drill press, belt sander, tube flaring machine, tube bender, hand tube master, lapping machine, grinder, metal saw, laminar flow benches, 3,000 psig GN<sub>2</sub>, and shop air. Approximately one-fourth of the space is partitioned off as offices.

16.9 S-II PROPULSION ORGANIZATIONAL WORK AREA

Location: LC-39, VAB Low Bay, Rooms 2M12, 2M13, and 2M14

Area: 1,037 Square Feet, Total

Function: Currently downmoded. During Apollo/Skylab flows, was used for organizational maintenance of GSE pneumatics panels

used in S-II operations, and for insulation batch testing.  
Used for minor component repair, inspection, and testing.

Equipment: Controlled environment room, not rated as clean room.  
3,000 psig GN<sub>2</sub> and GHe. Regulated pneumatics supply panels.

16.10 S-II ORGANIZATIONAL WORK AREA

Location: LC-39, VAB Low Bay, Rooms 1M1 thru 1M5

Area: 5,533 Square Feet

Function: Currently this area is used in support of storage and surveillance of S-II stages in Cells 5 and 6, and for storage of mechanical and electrical equipment required to check-out an S-II flight stage. During Apollo/Skylab flows, served as area for minor repairs, bench testing, adjustment, minor fabrication, and inspections by technicians assigned to checkout and maintenance of the S-II stage.

Equipment: Drill press, band saw, sheet metal shear, tube bender, etc.  
3,000 psig GN<sub>2</sub> and GHe available.

16.11 CONTRACTOR PROPULSION CHECKOUT WORK AREA

Location: LC-39, VAB Low Bay, Rooms 2K14, 2K14A, and 2K15

Area: 1,793 Square Feet

Function: Bench testing, adjustment, calibration, and repair of some components for which the contractor has operations and maintenance responsibility. This includes test hoses and equipment.

Equipment: Laminar flow benches, ultrasonic cleaner, pressure gage calibration panel (transfer standard), etc.

16.12 CONTRACTOR ORGANIZATIONAL WORK AREA

Location: LC-39, VAB Low Bay, Room 1K15

Area: 650 Square Feet (part of uncompartmented room)

Function: Used on "as required" basis to support priority functions using personnel borrowed from other work areas.

Equipment: Lathe, punch, notcher, grinder, welder, saw, etc.

## SECTION XVII

### MANNED PAYLOADS CHECKOUT FACILITIES

#### 17.1 GENERAL

The Manned Payloads Checkout Facilities support test and checkout operations of the manned spacecraft, and field maintenance and calibration activities.

Component testing, system checkout, and failure analysis are performed in these facilities for both flight and ground checkout.

#### 17.2 ASSEMBLY AND TEST AREAS

Location: O&C Building, M7-355 (see Figure A-1), High and Low Bays

Area: 50,000 Square Feet, Total

Function: Final assembly, checkout, and preflight preparation of manned spacecraft.

Equipment: Test stands, 25-ton bridge cranes, 1-ton crane, support stands, and clean rooms (Class 10,000 and 100,000).

#### 17.3 CONTROL CENTER (FOR CHECKOUT OF MANNED SPACECRAFT)

Location: O&C Building, M7-355

Area: 10,000 Square Feet, Approximately

Function: Command, display, recording, and control center for all testing and launch areas for manned spacecraft.

Equipment: RF receiving, recording, monitoring, and distribution equipment for S-band, C-band and video station - RIF; digital, analog, and tone-signal demodulator with display and recording consoles; computer control, modulation and demodulation, and digital readout recording equipment; control, display, recording, and command consoles for spacecraft subsystems; and signal distribution and switching equipment.

#### 17.4 BIOMEDICAL LABORATORY (MEDICAL SUPPORT FACILITY)

Location: O&C Building, M7-355, Rooms 3215, 3219, 3220, and 3263

Area: 3,210 Square Feet, Total



Function: Checkout of the flight operational biomedical instrumentation.

Checkout of flight operational experiments.

Perform astronaut physical examinations.

Determine power and data collection requirements for astronaut physicals.

Provide technical assistance to the Occupational Health Facility.

Provide a quarantine area.

Equipment: Approximately \$350,000 of electronic and medical test equipment, including refrigerators, freezers, and incubators.

#### 17.5 OPTICS LABORATORY

Location: O&C Building, M7-355, Room 1277

Area: 800 Square Feet

Function: Dark room facility used for camera loading/unloading operations.

Equipment: Class 100,000 clean room with a class 10,000 tunnel.

#### 17.6 RF COMMUNICATIONS LABORATORY

Location: O&C Building, M7-355, Rooms 3221, 3227, 3229, and 4227

Area: 3,657 Square Feet, Total

Function: Capability exists for checkout of Unified S-Band, CSM, and Lunar Module Systems; two-way voice and CSM tone ranging; PCM and FM/FM reception and demodulation; Spacecraft Command System; RF power, frequency, and modulation measurements and strip chart recordings; onboard TV camera/transmission; voice interface between spacecraft and ASTRO Communications System; etc.

Equipment: VHF receivers, S-band receivers, antenna control racks, antennas, spacecraft communications test station, digital command system, color TV monitor, etc.

17.7 ASTP-SOYUZ VHF RANGING SYSTEM

Location: O&C Building, M7-355, Room 1291

Area: 937 Square Feet

Function: Checkout of GSE and flight hardware equipment destined to the USSR in support of the ASTP-VHF Ranging System.

Equipment: VHF ranging test consoles.

17.8 J-MISSION LABORATORY

Location: O&C Building, M7-355, Room 1289

Area: 1,060 Square Feet

Function: Preflight checkout of flight experiments.

Equipment: Table, work benches, and cabinets. The facility maintains a 100,000 class clean room with air lock.

17.9 GENERAL PURPOSE LABORATORY

Location: O&C Building, M7-355, Room 2276

Area: 1,200 Square Feet

Function: Preflight checkout and testing of flight experiments.

Equipment: Pneumatic pressure and vacuum test set, data collecting and recording equipment, various pieces of electronic test equipment, etc.

17.10 SPACECRAFT ASSEMBLY AND ENCAPSULATION BUILDING #1

Location: Building M7-1469 (See Figure A-1)

Area: 18,000 Square Feet

Function: Processing the Viking Spacecraft

Equipment: Sterilization and hypergol service capability, motorized high bay door, and Class 100,000 clean room equipment.

17.11 SUPPLY, SHIPPING, AND RECEIVING BUILDING

Location: Building M7-505 (see Figure A-1)

Area: 94,200 Square Feet

Function: Provides space for maintenance and modification shops, storage control of ground support equipment, and parts required to assemble and prepare a spacecraft.

Equipment: Shipping, receiving, processing, and controlled storage area; ready storage space for items requiring controlled environment; and storage area for ground service equipment, cleaning, maintenance, and plastic shops.

17.12 SPACECRAFT ASSEMBLY AND ENCAPUSLATION BUILDING #2

Location: Building M7-1212 (see Figure A-1)

Area: 6,498 Square Feet

Function: Provides space and equipment for testing, fueling, servicing, and checkout of spacecraft hypergolic propulsion systems.

Equipment: Two test cells with 10-ton bridge crane (45-foot hook height), equipment for testing and servicing a completely fueled spacecraft, laboratory for pre-installation acceptance of spacecraft components, etc.

17.13 SPACECRAFT SYSTEM SUPPORT BUILDING #1

Location: Building M7-1210

Area: 6,547 Square Feet

Function: Provides space and equipment for processing Viking Spacecraft.

Equipment: Two test cells with 10-ton bridge cranes (45-foot hook height), equipment (laboratory) for validation of spacecraft components, equipment for testing and servicing a completely fueled spacecraft, etc.

17.14 RF TEST FACILITY (ANTENNA RANGE)

Location: Buildings M7-863 and M7-867

Area: 1,200 Square Feet, Total

Function: Test antennas from L-band to X-band.  
  
Tested radars during Gemini and Apollo programs.

Equipment: Test positioner, operating console, signal source, field amplitude probe, adjustable mounting fixture, transmitting tower hoist and carriage, 50-foot tower, etc.

## APPENDIX A

### AREA MAPS

Figures A-1, A-2, and A-3 are area maps showing the locations of the various buildings called out in the text of this document.

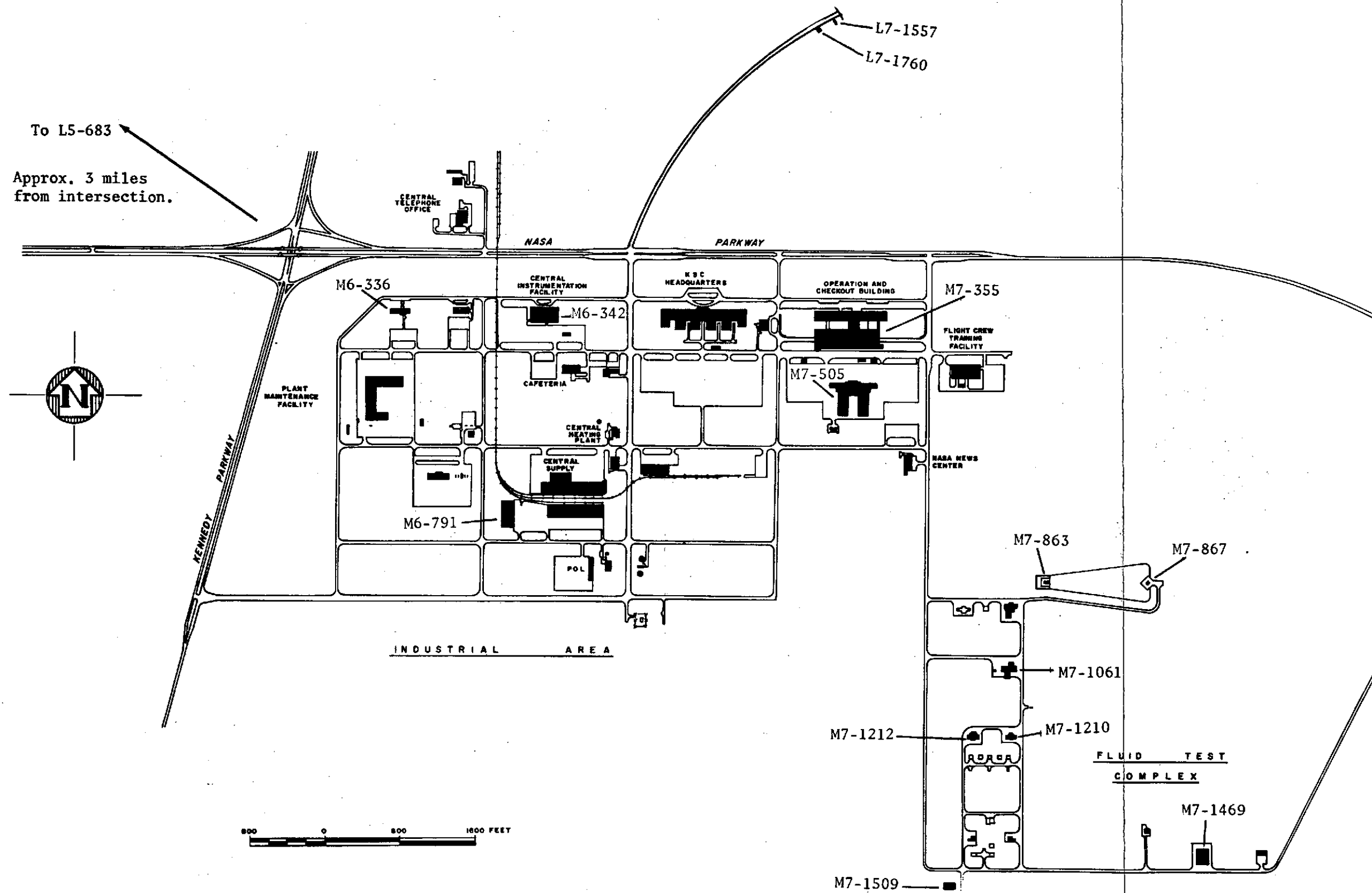


Figure A-1. KSC Industrial Area

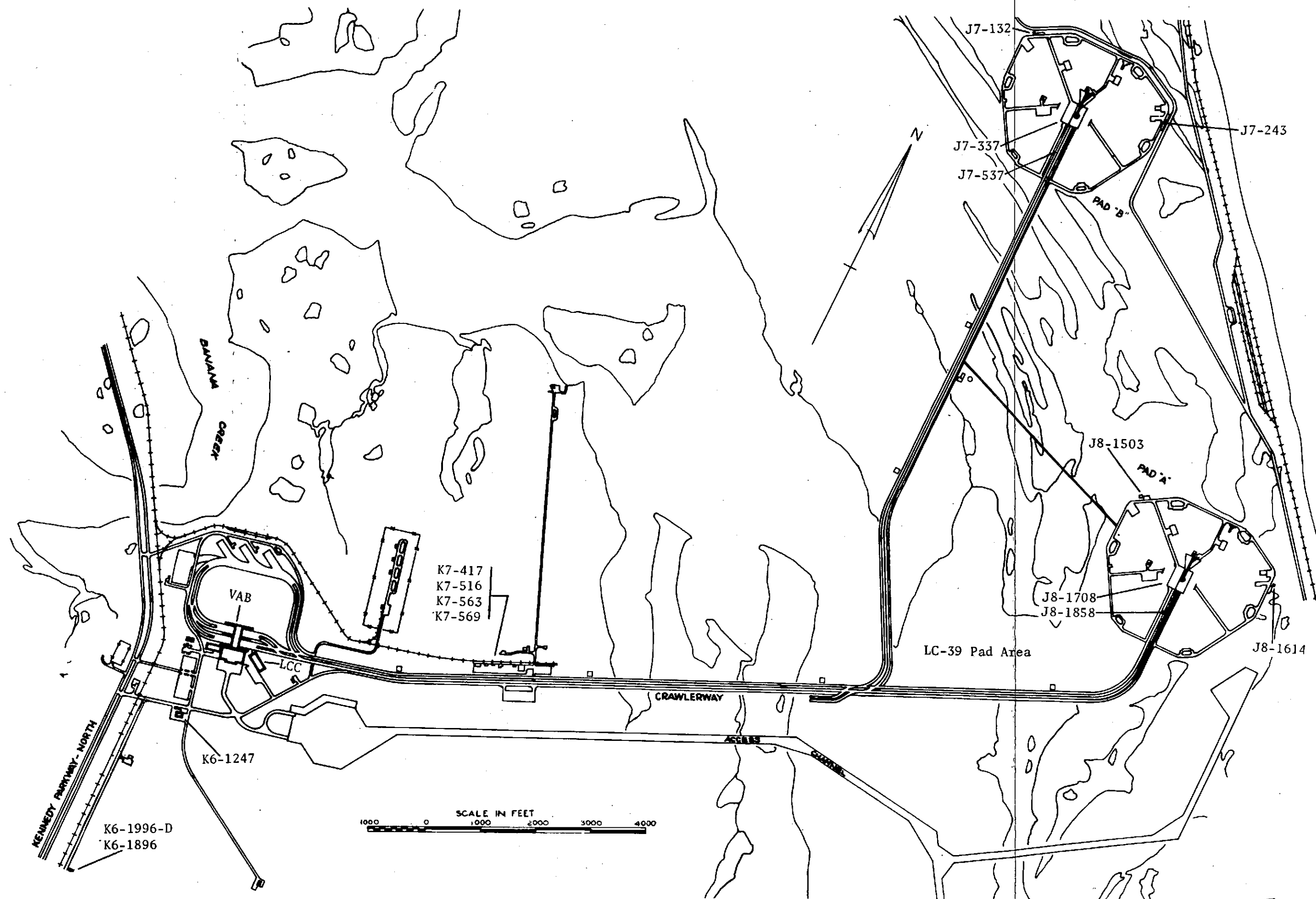
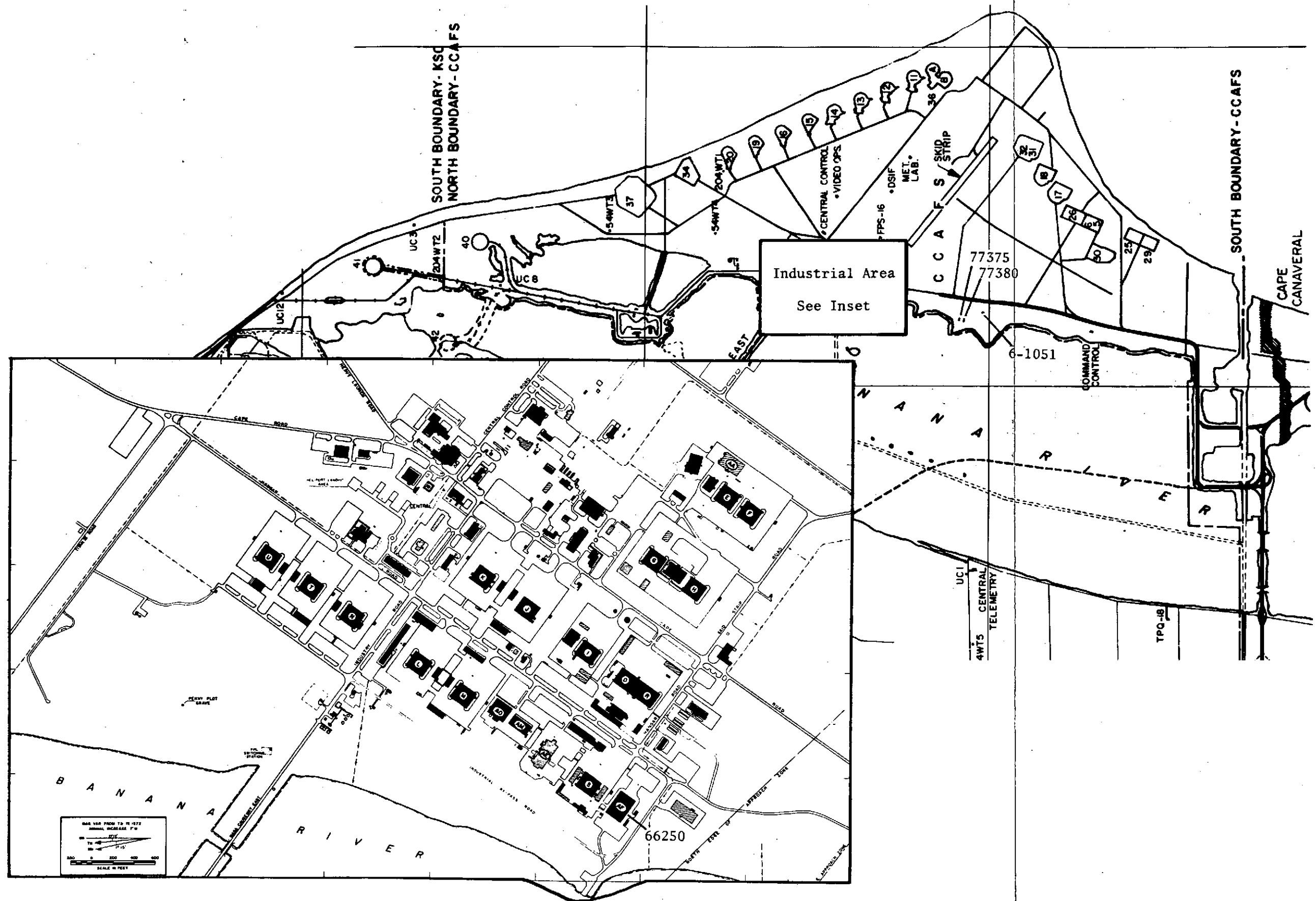


Figure A-2. Launch Complex 39 Area



APPENDIX B  
EQUIPMENT LIST

SECTION I

1. PRESSURE/TEMPERATURE LABORATORY

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Mueller Temperature Bridge	Leeds & Northrup	8069-B
Ice Point Thermocouple Reference	KAYE Instruments	K-170
Quartz Thermometer	Dymec	2801-A
Temperature Chamber	Delta Design	MK-7600 SD
Oil Calibration Bath	Rosemount	913-A
Platinum Probes (Standards)	Rosemount	162-C
Ice Calibration Bath	Rosemount	911-A
Triple Points Standards	Trans-Sonics	130
Pressure Calibration System	Texas Instruments	145
Pressure Calibration System	Ruska Instruments	2450.2M
Pressure Calibration System	Ruska Instruments	2465
Voltage-Current Calibrator	John Fluke	382-A
Material Testing System	Research, Inc.	900.85
Portable Gas Supply System	Union Carbide	PGS-45

2. VIBRATION AND ACOUSTIC LABORATORIES

Acoustic Calibrator	Photo Research	PC-125
Acoustic Calibrator	General Radio	1562-A
Sound Level Meter	B&K	2203
Sound Level Meter	General Radio	1551-C
Rate of Turn Table	Genisco	C-181
Micro-Flat Table	Collins	
Gage Block Set	Brown & Sharpe	
Sine Bar	Taft & Pierce	9118-10
Sine Bar	Taft & Pierce	9118-20
Anechoic Chamber	Edkel Corp.	666-250
Sound Vibration Analyzer	General Radio	1564-A
Vibration Calibration System	Unholtz Dickie	300
Tilt Table	LTV	201-T
Wave Analyzer	General Radio	1900-A

3. MEASUREMENTS COORDINATION LABORATORY

Card Punch	IBM	1058
Card Reader	IBM	1056
Printer	IBM	1052



#### 4. METEOROLOGICAL LABORATORY

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Wind Speed and Direction Calibration System		
Field Meter Test Stand		
Potential Gradient Test Stand		
High Voltage Screen Room		

#### 5. PROTOTYPE LABORATORY

Hot Stamp Machine	Kingsley	KTE-6
Taping Machine	Multi-Products	U-B-3
Cable Wrapping Machine	Multi-Products	W-B-3
Sleeving Cutter	McDonald Co.	Little Joe
Cable Tester	VJ Electronics	
Cable Footage Meter	Olympic	
Insulation Tester	General Radio	1863
Insulation Tester	Rhode & Schwarz	
Insulation Tester	Associated Research	224-A

#### 6. WAVE ANALYSIS LABORATORIES

Vibration Analysis System	Gultan	
Vibration Analysis System	Technical Products Co.	TP-625
Probability Density Analyzer	B&K	160
Amplitude Probability Analyzer	Gultan	
Magnetic Tape Loop	CEC	2810
Variable Electronic Filter	SKL	308-A
Tape Recorder/Reproducer	Ampex	1800
Tape Recorder/Reproducer	CEC	VR-3700
Oscilloscope	CEC	5-133
Integrating Amplifiers	CEC	System D
Tape Search and Control	Astrodata	6222
Tape Search and Control	Systrom Donner	8100
Demultiplexer	EMR	210 and 4130
Audio Frequency Spectrometer	B&K	2112
Audio Spectrum Analyzer	HP	8054-A
Recorder/Reproducer	Sangamo	4700
Recorder/Reproducer	Honeywell	760
Recorder/Reproducer	CEC	2800
Octave Band Analysis System	B&K	
Steady State Octave Band Analysis System	B&K	
Flexowriter	Friden	2300
Tape Memory System	Ampex	TM-9
X-Y Plotter	Houston Omnigraphic	6810

#### SECTION IV

##### 1. EMC VAN 1, HE 703-002

Electrical Generator, 10 kVA	Onan	12JC-3R-3950K
Air Conditioner	Carrier	50DA
Signal Generator	Polarad	1108

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Signal Generator	Polarad	1107
Signal Generator	Hewlett-Packard	8616A
Signal Generator	Hewlett-Packard	8614A
Spectrum Analyzer	Hewlett-Packard	8551A/851A
Electronic Counter	Hewlett-Packard	5245M
Frequency Divider	Hewlett-Packard	5260A
X-Y Plotter	Moseley/HP	2D-2AM
RF Control Unit	Local	N/A
Power Supply	Harrison Laboratory	6267A
Digital Display Unit	Singer/EMC	3100
10-Channel Callup Unit	Singer/EMC	8010
UHF Receiver	Singer/EMC	EMA-910
Antenna Positioner	Scientific Atlanta	3650/3770/3730/4100
Communications Amplifier	Local	N/A
450 MHz Command Receiver	Motorola	N/A
Strip Chart Recorder	Hewlett-Packard	680M
Power Meter	Hewlett-Packard	431B
Comb Generator	Hewlett-Packard	8406A
Special Purpose Receiver	Nems Clarke	2701
Radio Transceiver	Comco	AN/URC-54
Radio Interference Meter	Stoddart	NM-22A
Electronic Counter	Hewlett-Packard	5245L
Interference Analyzer	Fairchild	EMC-25
Scan Programmer	Fairchild	ESC-125A
Video Monitor	Conrac	
Power Meter	General Microwave	454AR
Antenna Positioner	Scientific Atlanta	4100
Signal Generator	Singer	SSG-1
Frequency Synthesizer	Hewlett-Packard	5105A
VHF Preamplifier	Electro/INT	AP-501R
UHF Preamplifier	Electro/INT	AP-502R
Oscilloscope	Hewlett-Packard	140A
Signal Generator	Hewlett-Packard	612A
8-Channel Strip Recorder	Clevite/Brush	Mark 200
14-Channel Tape Recorder	Ampex	FR1300
Audio Amplifier	Local	N/A
Audio Amplifier	Bogan	M330A
UHF Timing Receiver	Cubic	N/A
UHF Timing Decoder	Metric	8033-2
Communications Transceiver	General Electric	N/A
Oscilloscope Camera	Hewlett-Packard	197A
Recording Oscillograph	Consolidated Electro.	5-124
Radio Interference Meter	Stoddart	NM52A
Public Address System	Bogan	BT-20A
6-Foot Dish Antenna	Scientific Atlanta	22-6/C-J231
Log Spiral Antenna	Dorne/Margolin	DMAR-18
Log Periodic Antenna	Scientific Atlanta	26.0.1
Discone Antenna	Dorne/Margolin	AR-62-1
Monopole Antenna	Dorne/Margolin	DMAR60-1
Whip Antenna	N/A	N/A

Various filters, amplifiers, attenuators, patch panels, RF and audio OIS circuits, and telephone and countdown clock indicators.

2. EMC VAN 2, HE 703-037

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Electric Generator, 10 kVA	Onan	15JC-4R/7647R
Air Conditioner	Carrier	50DA
Antenna	Scientific Atlanta	3011/K245
Antenna Positioner	Scientific Atlanta	5614-S1-L
Antenna Position Indicator	Scientific Atlanta	N/A
Positioner Control	Scientific Atlanta	4100
Tracking Control	Scientific Atlanta	3770
Manual Command	Scientific Atlanta	3700
Positioner Control	Scientific Atlanta	3650
UHF Timing Receiver	Cubic	USAF/388331
Digital Display	Singer	3100
10-Channel Callup Unit	Singer	8010
Control	Singer	EMA-910
Frequency Selection	Singer	EMA-910
RF Patch Panel	FAB	N/A
Data Evaluation	Singer	EMA-910
Digital Analog Converter	Hewlett-Packard	6933A
DC Power Dupply	Hewlett-Packard	6267B
Network Analyzer Interface	Hewlett-Packard	8419B
Polar Display	Hewlett-Packard	8414A
Phase-Gain Indicator	Hewlett-Packard	8413A
Network Analyzer	Hewlett-Packard	8410A
System Control Panel	Hewlett-Packard	N/A
Signal Processor	Hewlett-Packard	85400A
Auto/Manual/Output	FAB	N/A
Frequency Synthesizer	Hewlett-Packard	5105A
Synthesizer	Hewlett-Packard	5110B
Synthesizer Programmer	Hewlett-Packard	2759B
Processor	Hewlett-Packard	85402A
Tracking Filter	Hewlett-Packard	8710A
Power Meter	Hewlett-Packard	432A
Leveling Amplifier	Hewlett-Packard	8404A
Sweep Oscillator	Hewlett-Packard	8690A
Signal Multiplexer	Hewlett-Packard	8705A
RF Unit Holder	Hewlett-Packard	8707A
Time Code Generator	Datum	N/A
Extender	Hewlett-Packard	2150A
Tape Reader	Hewlett-Packard	N/A
Interface Unit/Time Base	IN-TEL-32 (Local)	N/A
Generator	Hewlett-Packard	N/A
Countdown Clock	-	-
Computer	Hewlett-Packard	2116B
Cartrafile Recorder	Hewlett-Packard	N/A
Power Supply	Hewlett-Packard	2160A
I/O Cards	Hewlett-Packard	N/A
A/D Converter	Hewlett-Packard	5610A
Systems II Auto/Surveillance	N/A	N/A
Systems II Power Supply	N/A	N/A

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Frequency Receiver	Specific Products	WVTR
Interference Meter	Faichild	EMC-25
Patch Panel	-	-
Patch Panel	-	-
Calibration Attenuator	-	-
Manual Control	Fairchild	for EMC-25
OIS Control	Collins	-
Modem	ICC	4400/48
Modem 1 and 2	Milgo	-
X-Y Display	Hewlett-Packard	1300A
Telemetry Receiver	Defense Elect.	TR-711
Relay Unit	Hewlett-Packard	9300A
VHF Attenuator	Hewlett-Packard	E46-355D
Electronic Counter	Hewlett-Packard	5245M
Synthesizer Programmer	Hewlett-Packard	2759A
Digital Tape Unit	Hewlett-Packard	2020
Tape Punch Unit	Hewlett-Packard	-
Countdown Decoder	Hewlett-Packard	1035
Strip Chart Recorder	Hewlett-Packard	680M
Recording Oscilloscope	CEC	5-124
DC Amplifier	Dynamics	6671
Digital Voltmeter	Hewlett-Packard	3440A
A to D Converter	Hewlett-Packard	5610A
Visual Display Unit Recorder	Ampex	-
Tape Recorder	Ampex	FR1300
Speaker	-	-
Transceiver	General Electric	-
Audio Amplifier	Knight	-
UHF Timing Decoder	-	-
Timing Terminal Unit	Cubic	2220

### 3. ELECTROMAGNETICS LABORATORY

Transient Recorders  
 Spectrum Analyzers  
 RF Field Intensity Meters  
 Signal Sources  
 Oscilloscopes  
 Instrumentation Tape Recorders  
 Chart Recorders  
 Gauss Meters  
 Vector Voltmeters  
 Frequency Synthesizers  
 Power Meters  
 VSWR Measuring Equipment  
 Frequency Meters  
 Preamplifiers

#### 4. CIF ANTENNA FACILITY

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
24-Foot Diameter Antenna	Conago	TTS-2A
Rod and Disc Antenna	Scientific Atlanta	N/A
19-Foot Diameter Antenna	Atlantic Laboratories	N/A
6-Foot Diameter Antenna	Temec	N/A
Video Recorder	Ampex	VR-2000
Magnetic Tape Recorder	Ampex	FR-1800
Magnetic Tape Recorder	Ampex	FR-1200
Strip Chart Recorder	Brush	200
Phase-Lock Receiver	Interstate	GCR
Telemetry Receiver	DEI	TMR-18
Digital Data Processing Unit	Honeywell	DDP-516

#### SECTION VI

##### 1. ELECTRONICS LABORATORY

DC Standard and Differential Voltmeter	Hewlett-Packard	740B
Digital Voltmeter	Hewlett-Packard	3440
Digital Multifunction Meter	Hewlett-Packard	3450
Guarded Wheatstone Resistance Measuring System	Electro Scientific Industries	231B
General Purpose Oscilloscope	Tektronix	545
Dual Beam General Purpose Oscilloscope	Tektronix	555
Memory Oscilloscope	Tektronix	549
Memory Oscilloscope	Tektronix	564
Transistor Curve Tracer	Tektronix	575
Time Domain Reflectometer with Model 140 Oscilloscope	Hewlett-Packard	1415A
Television Waveform Monitor	Tektronix	525
RF Sweep Oscillator, with plug-ins (400 kHz to 12.4 GHz)	Hewlett-Packard	8690
Random Noise Generator	General Radio	1390B
Test Oscillator (10Hz to 10MHz)	Hewlett-Packard	652A
Preset Counter	Computer Measurements	776C
DC Standard	Hewlett-Packard	740B
HF Signal Generator (50kHz to 65MHz)	Hewlett-Packard	606
VHF Signal Generator (10 to 480 MHz)	Hewlett-Packard	608
UHF Signal Generator (450 to 1230 MHz)	Hewlett-Packard	612
UHF Signal Generator (800 to 4200 MHz)	Hewlett-Packard	614A
Pulse Generator	Hewlett-Packard	214A
Low Frequency Function Generator, with plug-ins	Hewlett-Packard	3300

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
SHF Signal Generator (3.8 to 11 GHz)	Hewlett-Packard	618B
FM/AM Signal Generator (195 to 270 MHz)	Hewlett-Packard	202J
FM/AM Signal Generator (54 to 216 MHz)	Hewlett-Packard	202E
Telechrome Test Signal Generator	Telemet Co.	3508
Wave Analyzer	Hewlett-Packard	302
Megohm Bridge	General Radio	1644A
Ratioarm Capacitance Bridge	General Radio	1615
Ratioarm Impedance Bridge	General Radio	1608
Distortion Analyzer	Hewlett-Packard	334A
Automatic Noise Figure Indicator	Airborne Instruments Labs	74A
Phase Meter	Acton Laboratories	320-AB
Microwave Power Meter	Hewlett-Packard	431B
Peak Power Calibrator	Hewlett-Packard	434A
Frequency Counter, with plug-ins	Hewlett-Packard	5245
Millivolt Potentiometer	Lead & Northrup	K-4
Frequency Selective Voltmeter	Philco	128A
Binary Waveform Generator, with plug-ins	Data Pulse	200
Temp. Meas. Equip. (Ice-Point Reference + Mod. 8686-1 Pot.)	Leads & Northrup	
3-Phase Power Supply (2250 VA and 50 to 1350 Hz)	Invertron	-
Variable Frequency AC Power Supply	Invertron	161A
Power Supply/Amplifiers	Hewlett-Packard	6824A
Magnetic Tape Recorder, with direct FM capability to 300 kHz	Ampex	FR-100
Video Magnetic Tape Loop Machine with 300 to 1 speed differential	Ampex	
Thermal Writing	Hewlett-Packard	7700
Oscillographs, with preamp options	-	-
Digital Printer, with digital clock	Hewlett-Packard	562
Optical Oscillograph (to 5kHz)	Honeywell	1508
X-Y Plotter	Hewlett-Packard	135C
Network Analyzer	Hewlett-Packard	8407A
Phase-Magnitude Display	Hewlett-Packard	8412A
Polar Display	Hewlett-Packard	8414A
Microwave Network Analyzer	Hewlett-Packard	8410A
Phase-Gain Indicator	Hewlett-Packard	81413A
Reflection-Transmission Test Unit	Hewlett-Packard	8743A
S-Parameter Test Set	Hewlett-Packard	8745A

## 2. METALLURGICAL LABORATORY

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Band Saw	Whitney	A24V
Microscope	Buehler	D-5001
Stereo Microscope	Buehler	D-2019
Microscope		624-009
Metallograph	Vickers	55
Polisher	Buehler	64-1912AB
Polisher	Buehler	46-1511AB
Vacuum Etcher	Buehler	4
Polisher	Buehler	47-1853AB
Polisher	Fisher	12-260-5V1
Etcher Polisher	OSI	53C
Hardness Tester	Wilson	5TT
Furnace Control	Lindberg	59344
Furnace Box	Lindberg	51442
Furnace Control Console	Lindberg	59344
Vacuum Oven	Fisher	13-262-12V3
Cutoff Abrasion Wheel	Buehler	45800
Cutoff Machine	Geoscience	100
Crucible Furnace	Lindberg	56622
Etcher	Buehler	70-1740
Microscope	Aospencer	58M-D3
Light	Leitz	000
Vertical Illuminator	Leitz	I Draw
Machine Finish	Delta	31-520
Radilcutter	Ralmike	006-3
Refrigerator	RFG	FD14TGL
Hevi-Duty Furnace (2)	Lindberg	5144-7527
Hardness Tester	Ames	2
Clean Air Bench	Agnewhiggen	462
Stereo Microscope	Wild	M5

## 3. MECHANICAL SYSTEMS AND FLUIDS LABORATORY

Counter (2)	Hewlett-Packard	522B
Manometer	Meriam	30EB25
Drawing Table	Tracmaster	
Clean Bench	Whifman	65
Micrometer Caliper (4)	-	-
Blockset Gage		36
Gage	Bausch & Lomb	33-19-14
Micrometer Depth Gage (2)	-	-
Vernier Gage		254-18
Borescope	American/Cystoscope	B78R
Borescope	National/Elec.	313-27RA
Borescope		450-27CC
Stroboscope	Electro	G/R1531A
Magnatest	Magnaflux	FM-120
Microscope	Amer/Optical	28LF

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Pneumatic Test Console	Amniso	-
Surface Plate	Granite	
Optical Comparator	J/L	EPIC 30
Pneumatic Console		01-67010
Surface Analyzer		1121AALS
Decade Resistor (2)		1432Z
Oscilloscope	Tektronix	549
Camera	Tektronix	C12
Power Supply	Sorensen	QRC404A
Borescope		B124A
Lathe		A
Precision V-Block (2)	Granite	
Speed Press (2)	Buehler	20-1331
DMD Type Band Saw		77
Vacuum Pump	Welchduo-Seal	1402
Pyrometer	Buehler	R-3000
Multimeter	Weston	980
Electric Drill (1/4" Portable)		
Plug-In Unit	Tektronix	
Milling Machine	Bridgeport	6-1035-00264
Grinder	NAR	438-02-314-0186
Lathe	Fairchild	5914
Comparator	J/L	TC10
Ultrasonic Cleaner (2)		
Stop Watch (3)	Cletimer	
Compression Tester	CHT	DPPH100
Band Saw (20-inch)	Rockwell	28-350
Metal Saw	Wells	M8-110
Torch Set	Tescom	23-1004
Electric Butt Welder	Doall	DBW15
Vernier Caliper	STA	123-36
Vernier Gage	Lufkin	C-800A
Tool Grinder	Rockwell	23-501
Still Picture Camera	POD	MP3
Gage Block	BRS	598-81-14
Manometer	WTI	A187
Liquid Measure	Gurley	9930
Manometer	Meriam	30E825
Manometer (3)	Meriam	34FB2
Gage (2)	Futurecraft	90420
Reflectometer	Hewlett-Packard	1415A
Optical Ring	Steelcity	
Velometer	Alnor	3002
Vacuum Meter	Fredricks	2A
Flow Meter (2)	NIL	20-10-5
Gage Blocks	STA	ARC81A1
Pneumatic Safety Chamber	FAB	
Intensifier	Futurecraft	90739
Calibration Kit	Futurecraft	90255



<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Micrometer (5)	Mitutoyo	103217
Micrometer	STU	T12LNR
Micrometer Depth Gage (8)	Mitutoyo	
Micrometer	STU	436-9
Pumping Station	VAR	PS10
Leak Detector	VAR	13581
Leak Detector	G.E.	A248AN2
Sine Plate	BRS	599925-10
Micrometer	Vankeuren	60-112
Micrometer	BRS	5996056
Micrometer	Lufkin	1944V
Micrometer (2)	STA	700
Micrometer (4)	BRS	30-1
Micrometer	STA	124-C
Micrometer	STU	T9
Micrometer	STA	436-11
Micrometer Set	MLF	41C307-10
Inside Micrometer	STU	
Vernier Height Gage	BRS	586
Micrometer	STA	4363
Vernier Caliper (49-inch)	STA	122
Micrometer	STA	436-2
Micrometer	STA	436-5
Micrometer	Tubularm	
Power Supply	L/N	099034
Micrometer (9 to 10-inch)	Scherr-Tumico	
Micrometer (8 to 9-inch)	Scherr-Tumico	
Micrometer (6 to 9-inch)	Scherr-Tumico	
Gas Booster	Haskel	AG152C
Preset Counter	CMC	776C
Metal Lathe	Rivett	957-1203-6R
Shoe Cleaner	Liberty	400A1
Helium Leak Detector	Veeco	MS9
Leak Meter	GRU	LSC430-6599-1
Micro Tool Kit	Jensen	MTK3
Microscope	Olympus	XTR100
Pumping System	Autoclave Eng.	
Temperature Chamber	Webber	AT6.5-140
Stereo Microscope	BLO	BV105
Leak Detector	G.E.	Type H
Table Positioner		
Rotameter Kit (2)	BTC	1214-1355
Borescope		C1
Inside Micrometer		128
Digital Recorder	Hewlett-Packard	560A

## SECTION VIII

### 1. COMPONENT CLEANING AND TESTING SERVICE

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
250-Gallon Chemical Vats		
Fixed and Mobile Handling Equipment		
Vapor Degreasers		
Ultrasonic Cleaners		
Laminar Flow Clean Benches		
Hydraulic Test Console		
Hydraulic Proof-Test Console		
Filter Pore-Size Tester		
Packaging Equipment (heat sealers and vacuum source)		
Analytical Equipment (for particulate and NVR determination)		
Hand Tools, Lathes, Grinders, and other misc. tools and hardware.		

### 2. HYPERGOLIC DECONTAMINATION (COMPONENTS)

Air Removal System  
Neutralizer Tank  
Rinse Sink  
Work Benches  
Hand Tools  
Gaseous Nitrogen and Demineralized Water Storage and Distribution Systems  
Waste Chemical Holding Tank  
Emergency Breathing Equipment

### 3. IN-PLACE CLEANING AND TESTING

8,000-Gallon Mobile Chemical Tankers and Tractor  
Chemical Tanks  
2,400-Gallon Mobile Solvent Unit  
Solvent Circulating System  
2,000-Gallon Mobile Solvent Unit  
Automatic Boiler  
40 Horsepower Mobile Boiler Unit  
Centrifugal Pumps  
3,000 Mobile High-Pressure Pumping Unit  
6,000 Mobile High-Pressure Pumping Unit  
Storage Tanks  
Mobile Analytical Laboratories  
Skid-Mounted Hypergolic Decontamination Consoles  
Electric and IC Motor Driven Pumps (to 2,600 gpm)  
High Volume Pressure Reducing Panels  
Portable, Vertical, Laminar-Flow Booths

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
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Hydrostatic Testing Pumps (to 30,000 psig)  
 Tractors, Trailers, Vans, Pickups, Hand  
 Tools, Fittings, Flanges, Flexible Hoses,  
 Filters, Universal Power Adapter, etc.

#### 4. IN-PLACE HYPERGOLIC DECONTAMINATION

8,000-Gallon Mobile Chemical Tankers with Tractor  
 Chemical Tanks  
 2,400-Gallon Mobile Solvent Unit  
 Solvent Circulating System  
 2,000-Gallon Mobile Solvent Unit  
 Automatic Boiler  
 40 Horsepower Mobile Boiler Unit  
 Centrifugal Pumps  
 3,000 psig Mobile High Pressure Pumping Unit  
 6,000 psig Mobile High Pressure Pumping Unit  
 Storage Tanks  
 Mobile Analytical Laboratories  
 Skid-Mounted Hypergolic Decontamination Consoles  
 Electric and IC Motor Driven Pumps (to 2,600 gpm)  
 High-Volume Pressure Reducing Panels  
 Portable, Vertical, Laminar-Flow Booths  
 Hydrostatic Testing Pumps (to 30,000 psig)  
 Tractors, Trailers, Vans, Pickups, Hand Tools,  
 Fittings, Flanges, Flexible Hoses, Filters,  
 Universal Power Adapter, etc.

#### 5. HYDROGEN PEROXIDE PASSIVATION

Nitric Acid Tanks with Drainage and Disposal System  
 Hydrogen Peroxide Sinks with Drainage and Disposal System  
 Safety Showers and Eyewash Fountains  
 Laminar Flow Bench  
 Demineralized Water, Hot and Cold Potable Water,  
 Vacuum, and Nitrogen Gas Storage and Distri-  
 bution Systems  
 Ultrasonic Unit  
 Hand Tools, Work Benches, Analytical Apparatus,  
 Ventilating Hoods, Fittings, Heat Sealers,  
 Thermo-Dip Unit, etc.

#### 6. VESSEL AND HOSE CLEANING

Vats and Associated Pumping and Distribution Systems  
 Vessel Stands and Associated Staging  
 Hose Tower and Associated Hoists and Cables  
 K-Bottle Handling Racks  
 Portable Laminar-Flow Down-Flow Clean Booths

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Work Benches and Hand Tools		
Waste Chemical Holding Tanks		
Expansion Joint Restraining Fixtures		
Steam Boiler		
Demineralized Water and Gaseous Nitrogen Supply and Distribution Systems		

## SECTION IX

### 1. FLUID SAMPLING

1/2-Ton Trucks  
 Millipore Filter Holders  
 High Pressure Hoke Stainless Steel Cylinders  
 Glass Sampling Bottles  
 Pressure Reducing Panels  
 Cosmodyne Cryogenic Samplers  
 Thief Sampler  
 Drum Probes  
 Vacuum Sources  
 Psychrometers  
 Connecting Hardware  
 Various Tools

### 2. SPECIFICATION CONFORMANCE ANALYSES

Atomic Absorption Spectrophotometers  
 Infrared Spectrophotometers  
 Gas Chromatographic Systems  
 Ultraviolet Spectrophotometers  
 Moisture Analyzers  
 Hydrocarbon Analyzers  
 Automatic Distillation Equipment  
 Automatic Moisture Titration Equipment  
 Conductivity Analysis Equipment  
 pH Meters  
 Oxygen Analyzers  
 Ovens  
 Microscopes  
 Analytical Balances  
 Cooling Baths  
 Normal Laboratory Equipment (benches,  
 hoods, glassware, etc.)

### 3. TITANIUM COMPATIBILITY TESTING SERVICE

Exposure Cells  
 Load Frames  
 Environmentally Controlled Enclosures

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Reverse-Cycle Heat Pumps		
Fume Hoods		
Standard Weights		
Levelling Jacks		
Drip Pans		

#### 4. RESIDUAL GAS ANALYSIS

Mass Spectrometer  
 Vacuum Pumping Equipment  
 Liquid Nitrogen Dewars  
 Recorder  
 Manifold Vacuum Containers  
 Water/Glycol Cooling Bath

### SECTION X

#### 1. NONDESTRUCTIVE TESTING

X-Ray Generation Instruments  
 Radioactive Isotope Units  
 Ultrasonic Sound Generating/Receiving Instruments  
 Magnetic Particle Equipment  
 Dye Penetrant Kits, Visible and Ultraviolet  
 Zyglo Unit  
 High Voltage Spark Testing Equipment  
 Automatic Film Processing Equipment  
 Closed Circuit Television Inspection System  
 Variable Light Intensity Film Viewers  
 Bearing Monitoring/Evaluation Equipment  
 Film Densitometers  
 Lead-Shielded X-Ray Cabinet with Variable  
 Position Platform  
 25 MEV Betatron, Laboratory Installed, X-Ray Unit  
 with Associated Handling, Positioning, and  
 Monitoring Equipment

#### 2. LEAK DETECTION

Mass Spectrometers  
 Ultrasonic Translators  
 Thermal Conductivity Indicators  
 Capillary Leak Standards  
 Fixed and Adjustable Probes  
 Roughing Pumps  
 Vacuum Indicators  
 Helium Supply and Spray Equipment  
 Miscellaneous Accessories

## SECTION XII

### 1. METALLURGICAL TESTING LABORATORY

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Universal Testing Machine	Tinius Olsen	-
Impact Tester	Tinius Olsen	-
Hardness Testers	Riehle-Wilson	-
Hardness Tester		Shore Scleroscope
Constant Load Stress-Corrosion Tester	-	-
Sectioning, Grinding, and Polishing Equipment	Buehler	-
Low-Power Binocular Microscope	Olympus	-
Microscope		AO Microstar
Arc Resistance Test Instrument	-	-
Dielectric Strength Test Instrument	-	-
Electrostatic Charge Test Instrument	-	-
Logic Circuit Rack Breadboard System	-	-
Electronic Voltmeter	Hewlett-Packard	410C
Vacuum Tube Voltmeters	Hewlett-Packard	400H and 410B
Insulation Resistance Bridge		
Oscilloscope with Plugins	-	-
Digital Recorder	Hewlett-Packard	C13-562A
Modulated Signal Generator	Singer	SG-8
Function Generators	-	-
Low Frequency Oscillator	Hewlett-Packard	202CR
Electronic Counter	Hewlett-Packard	5512A
Electronic Counter	ATEC	6B86
2-Channel Strip Chart Recorder	Hewlett-Packard	7100B
2-Channel Strip Chart Recorder	Sanborn	297
Electronic Milliohmmeter	Hewlett-Packard	4328A
Digital Voltmeters	-	-
Regulated DC Power Supplies	-	-
Portable Wheatstone Bridges	-	-
Hygrometer Humidity Indicator	-	-
Portable Volt & Current Meters (Bolometer)	-	-
General Purpose Multimeters	-	-
Standard Resistors	-	-
Standard Voltage Cells	-	-
Platinum Resistance Thermometers	-	-
Millivolt Potentiometer		
Electrometer	Keithley	610C
Integrating Digital Voltmeter	Hewlett-Packard	2401A
Clip-On DC Millammeter	Hewlett-Packard	428B
Differential AC-DC Voltmeter	Fluke	803
Oscillograph (Visicorder)	Honeywell	1508

## 2. PLASTICS AND ELASTOMERS TESTING LABORATORY

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
Universal Testing Machine		Instron
Convection Ovens		Blue M
Torsion Stiffness Tester		Clash & Berg
Heat Deflection Tester	-	-
Low Temperature Brittleness Tester	-	-
Laboratory Press		Dake
Balance		Mettler
Plastics Stiffness Tester	-	-
Precision Balance		Mettler P10
Rubber-Plastics Extruder	-	-
Granulating Machine	-	-
Impact Tester		Izod
Melt Flow Index Tester	-	-
Rubber-Plastics Mixing Mill	-	-
Plastics Injection Molding Machine	-	-
Plastic Heat Sealers	-	-
Quartz Dilatometer	-	-
Abrasion Tester		Taber
High Pressure Gas Permeability Cells	-	-
Creep-Rupture Testers	-	-
Micro Indentation Tester	-	-
Universal Penetrometer	-	-
Plasticorder	-	-
Torsion Stiffness Tester	-	-
Compression Set Apparatus	-	-
Hardness Testers (Durometers)		Barco
Flammability Tester	-	-

## 3. COATINGS EVALUATION LABORATORY

Sand Blast Cabinet	-	-
Spray Booth	-	-
Fluidized Bed Coating Equipment	-	-
Paint Shaker	-	-
Paint Mixer (air driven)	-	-
Pressure Pot	-	-
Spray Guns	-	-
Eddy Current Coating Thickness Indicator	-	Permascope
Scrape-Adhesion Tester	-	-
Exposure Frames and Racks	-	-

## 4. LUBRICANT TESTING LABORATORY

Flash Point Testers (open and closed cups)		
Viscosimeters		Brookfield, Saybolt, Cannon

<u>Item</u>	<u>Manufacturer</u>	<u>Model No.</u>
4-Ball Extreme Pressure Tester		
Friction and Wear Tester	Dow-Corning	LFW-1
Grease Working Machine and Penetrometer	-	-
Low Temperature Torque Tester	-	-
Functional-Life Ball Bearing Grease Tester	-	-
Water Washout Tester	-	-
Grease Dropping Point Tester	-	-
Evaporation Test Cells	-	-
Oxidation Resistance Test Cells	-	-
Cloud and Pour-Point Tester (for oils)	-	-
pH Meter		
5. LOX TESTING LABORATORY		
LOX Impact Tester	-	-
Oxygen Aging Apparatus	-	-
Vapor Degreaser	-	-
Drying Oven	-	-
Cryogenic Dewars	-	-
Cutting Press and Dies	-	-
Refrigerator	-	-
6. ENVIRONMENTAL TESTING LABORATORY		
High-Frequency Vibration Equipment	-	-
Shock Test Equipment	-	-
High-Temperature Ovens	Blue M	POM-256E
Temperature-Altitude Chamber	Tenney	27ST-100350
Temperature-Humidity Chamber	Tenney	T27UFR-100350
High Vacuum System	HVEC	8018
Portable Vacuum System	-	-
Salt Spray Chamber	Associated Test	MX-9216
7. OTHER EQUIPMENT		
Milling Machine	Bridgeport	-
Band Saw	-	-
Abrasive Cutoff Wheel	-	-
Drill Press	-	-
Tube Flaring Machine	-	-
Belt Sander	-	-
Punch Press (bench)	-	-
Arbor Press	-	-
Torque-Tension Tester	-	-



# SECTION XIII

## 1. MACHINE SHOP - LES

<u>Item</u>	<u>Description</u>	<u>Quantity</u>
1	Band Saw, Delta Model 280350, 19-3/4" throat; height of cut: 13-3/8"	1
2	Band Saw, High Speed, Tannewitz, friction sawing capability, 35-1/4" throat depth, 45° table tilt	1
3	Band Saw, Cutoff, Wells, Model 1214, 6"x12" capacity	1
4	Beader, Pexto, Model #622-E; capacity: 1/16 mild steel	1
5	Belt Sander, Delta Rockwell, Model 31-305	1
6	Bench Saw, Tilting Arbor, Delta, 10" blade	1
7	Boring Mill, Table type, Gidding & Lewis, No. 65 E4-T, 72"x36" Bed, 36" square airlift rotary table; capacity: 20,800 pounds	1
8	Cutoff Saw, Power, Racine, 8"x16" capacity	1
9	Die Filler, Milwaukee, Model F54	1
10	Dividing Head, Derney & Trecker	1
11	Dividing Head, Van Norman, S/N 6-3694	
12	Drill Floor, Avey, Drills from No. 80 to 1-1/4", automatic tapping attachment, No. 4 Morse spindle socket	1
13	Drill Pointer, Oliver, Model 600, 3" capacity	1
14	Drill Press, Radial 4-foot, Fosdick	1
15	Drill Press, Rockwell, Model 1520	1
16	Drill Press, Precision, Hamilton, 1/4" chuck	1
17	Drill Press, Walker Turner; 1/2" drill capacity	1
18	Engraver, Pantograph, Gorton, Model P-1-2; maximum throat depth: 16"	1

<u>Item</u>	<u>Description</u>	<u>Quantity</u>
19	Finger Brake, DiAcro, No. 12, 16 guage, 12" wide	1
20	Form Roller, DiAcro, Model #3, 18" capacity	1
21	Grinder, Gutter and Tool, Monoset, Cincinnati, spiral and straight capability	1
22	Grinder, Universal External and Internal, Grand Rapids, Model 1230, 12-15/16"x36"	1
23	Grinder, Surface, Grand Rapids, Model 570, magnetic chuck, 16"x36"	1
24	Grinder, Black Diamond, Model 21, drill sharpener sizes to 1/2"	1
25	Grinder, Cylindrical, Grand Rapids; capacity: 12" diameter by 24" long	1
26	Grinder, Surface, Grand Rapids, Model 570, electro-magnet bed, 16"x36" capacity	1
27	Grinder, Punch & Die, Strippit	1
28	Grinder, Gorton, Model 5KC35; used for engraving only	1
29	Grinder, Delta, Pedestal, Model 23-501	1
30	Grinder, Baldor, Pedestal, S/N 1264	1
31	Grinder and Buffer, U. S. Electric, Pedestal, 12" wheels	1
32	Hone, Sunnen, interchangeable mandrel sizes	1
33	Iron Worker, Buffalo, shear 1/2" plates, 6"x5/8" flats, bar cutter 4x4x1/2 angle, 1-5/8" rounds, 1-1/2" squares	1
34	Jig Borer, Fosmatic, Model 42P, 42"x18" table	1
35	Lathe, Heavy Duty, Hollow Spindle, LeBlond, sliding bed gap-lathe, 65" swing, spindle hole 12-5/8", center distance gap open, 144"	1
36	Lathe, Heavy Tool, LeBlond, 1610 NE, 60" center distance	1

<u>Item</u>	<u>Description</u>	<u>Quantity</u>
37	Lathe, LeBlond, 13" Regal, 54" bed, 48" center distance, 13" swing	1
38	Lathe, LeBlond, 28" medium duty sliding gap, 86" center distance gap open, threading dial for conventional and taper threading	1
39	Lathe, Toolmaker, Monarch EE, 12-1/2" swing, 20" bed	2
40	Lathe, Toolmaker, Monarch EE, 12-1/2" swing, 30" bed	1
41	Milling Machine, Toolmaster, Cincinnati, capable of 0.0005 inch tolerance, vertical slotting head, auxiliary mounted	1
42	Milling Machine, Bridgeport Universal, with shaping attachments, 42"x10" bed, 20" throat, 12" working height	3
43	Milling Machine, Kerney & Tracker, 17"x72" table, 30" throat, 18" working height	1
44	Milling Machine, Hardinge, small mill used for Electric Shop potting molds	1
45	Oven, Dry-Rod, Model 18	3
46	Oven, Dry-Rod, Model PP2	1
47	Oven, Dry-Rod, Model P-18	6
48	Oven, Welding Rod, Model PP8	1
49	Paint Oven, Devilbiss, 7' x 7-1/4" x 11' x 4"	1
50	Paint Booth with Water Wash Paint Spray, Devilbiss, 12' x 7' x 6'	1
51	Pan Brake, Chicago Dreis and Drump, box and pan type, pneumatic operated, 8 guage capacity	1
52	Planer, open side shaper, Rockford, 44" stroke, 24"x30" table	1
53	Positioner, Ransome, power rotating, used for pipe welding	1

<u>Item</u>	<u>Description</u>	<u>Quantity</u>
54	Positioner, Cayuga, power rotating, used for pipe welding, Model 05K812	1
55	Press Brake, Hydraulic, Krump Chicago, 300 ton, 10' bed, 12" stroke, 20" open height	1
56	Press Brake, DiAcro, Model 16-72; capacity: 1/8" mild steel, 6' long	1
57	Press, Acco, Model P1358, 8" ram, 150 ton, 18"x4' bed, 24" maximum working height	1
58	Riveter, Stationary Compression, Chicago Pneumatic, yoke reach 42"	1
59	Rotary Table, Fosdick, Type RS400K	1
60	Rotary Table, Troyke, Model BH12	1
61	Rotary Table, Palmgreen	1
62	Rotary Table, Kerney & Trecker, Model 9723	1
63	Rotary Table, Hartford, S/N 11788	1
64	Shear, Power Squaring, Lodge and Shipley; capacity: mild steel and aluminum - 1/2" thick x 8' long, stainless steel 1/4" thick x 8' long	1
65	Sheet Metal Fabricator, Sonic 15, Wales Strippet; table size with side tables: 36" width x 24" depth	1
66	Sheet Metal Fabricator, Super 30, Wales Strippet, 72" width x 48" depth table	1
67	Sheet Metal Shrinker, Erco, 1/16" aluminum capacity	1
68	Slip Roll, Lown, Model G500; capacity: 4' length x 8 gauge steel, 5" diameter rolls	1
69	Surface Plate, Steel, Swanson, 18"x24"	1
70	Surface Plate, Granite, 12"x12"x4" thick	2
71	Surface Plate, Steel, 10"x14"x2" thick, Challenge	2
72	Surface Plate, Steel, Machine Products, 18"x24"	1
73	Tab Notcher, DiAcro, hand operated, 1/16" mild steel	1

<u>Item</u>	<u>Description</u>	<u>Quantity</u>
74	Tapping Machine, Hamilton, Model TPL25	1
75	Turret Punch, DiAcro, hand operated, sizes 1/16" to 2"	1
76	Unisaw, Delta; maximum depth of cut: 3-1/8"; maximum rip to right of blade: 25"	1
77	Welder, Stud, Nelson, 5/8" capacity	1
78	Welding Machine, Hobart M300 (smaw), transportable	3
79	Welding Machine, Miller, (smaw), portable	1
80	Welding Machine, Hobart, (smaw), portable	1
81	Welding Machine, Miller Trailblazer (gtaw) and (smaw), portable	2
82	Welding Machine, Miller Heli-Arc, shop, 300 amp	1
83	Welding Machine, Miller Heli-Arc, shop, 500 amp	1
84	Welding Machine, Airco Heli-Arc, shop	1
85	Welding Machine, Lincoln Heli-Arc, shop	1
86	Welding Machine, P & H, AD-DC-SMAW and GTAW	2
2.	MACHINE SHOP - CIF	
1	Brake, Hand, box and pan, 12 gage by 4 feet, hand-operated	1
2	Brake, Hydra Power Press, DiAcro, No. 16-72	1
3	Brake, Finger, DiAcro, No. 24, Serial No. 1-2674	1
4	Drilling Machine, Gifford, Deland, Model 2 LMS; maximum distance spindle nose to table: 29"	1
5	File, Die Mod F, S, 4 Serial No. 5786	1
6	Grinder, Delta, Model 23-201, pedestal mounted	1
7	Grinder, Surface, Boyer Schultz, 13"x6"x11" high work range	1
8	Lathe, Tool Room, 14-inch, LeBlond; constant surface speed center distance: 30"; swing: 14"	1

<u>Item</u>	<u>Description</u>	<u>Quantity</u>
9	Layout Machine, DiAcro, precision layout, 18"x24" capacity	1
10	Microdrill, Dunmore, Model 27-021	1
11	Milling Machine, Gorton Mastermill, Model 1-22, half tolerance machine standards, variable speed, 12"x48" table	1
12	Punching Machine, Metal Fabricator, Unipress, Model 1020D, air operated, 24"x78" table	1
13	Notcher, Tab, DiAcro, Serial No. 1-1079	1
14	Press, Arbor, Mechanical, Manual, Famco No. 3	1
15	Punch, Terret, DiAcro, No. 18, Serial No. BE 1012	1
16	Saw, Band, Floor-Type, W. Whitney Stueck, Model 24-V, variable speed, 26" throat depth, 20"x22" table	1
17	Saw, Crane Table, Borce, Serial No. 1341, Model 13500	1
18	Shear, Squaring, Wysong, Model 748, 3/16"x48" shearing capacity	1
3.	ELECTRIC SHOP	
1	Freezer, Ultra Low Electric, Revco, Inc., Model ULT-107. This freezer is utilized in the potting and molding operations for the purpose of storing flash frozen epoxy and polyurethane compounds at temperatures ranging from 0°F to -90°F.	1
2	Label Machine, Cable, Kingley, Model M-100-BA. Utilized for hot-stamping cable labels.	1
3	Mixer, Polyurethane, Accumertric, Model 2CL-2-TOL-1005, S/N 1170016. This machine is utilized in the potting and molding operations to degass, store, and mix Type III polyurethane.	1
4	Oven, Potting and Molding, Hot Pack Model 608. These ovens are utilized in the potting and molding operations for the purpose of curing various types of epoxy and polyurethane compounds and are capable of maintaining 100°F to 250°F.	5

<u>Item</u>	<u>Description</u>	<u>Quantity</u>
5	Oven, Portable Potting and Molding, Custom Made. These ovens are utilized in the field potting and molding operations for the purpose of curing various types of epoxy and polyurethane compounds and are capable of maintaining 100°F to 250°F.	7
6	Press, Electric Drill, Duro, Model W9-3080. This drill press is equipped with a special explosion-proof motor and is utilized in the potting and molding operations for drilling vents and injection parts on various types of molds.	1
7	Pump, Vacuum, General Electric, Model 5KC4614G244. These vacuum pumps are utilized in the potting and molding operations for the purpose of degassing various types of epoxy and polyurethane compounds.	2
4.	ELECTRONIC SHOP	
1	Brazing System, Aeroquip Corp., Model SUP202, used for electronic induction brazing of stainless steel tubing from 1/4" O.D. to 2-1/2" O.D.	1
2	Cleaning Sink, Model 1110, used for cleaning process in circuit board fabrication.	1
3	Drill, High Speed, Hammer Co., Model R35, used for drilling component mounting holes in circuit boards.	1
4	Drill, High Speed, Hamilton, Model 40J1133102, used for drilling component mounting holes in circuit boards.	1
5	Eyelet Machine, Eyelet Tool Co., Model 101, used to install eyelets in printed circuit boards.	1
6	Gold Plater, Sel-Rex, Model XP15X, used to gold plate connector fingers on printed circuit boards.	1
7	Notcher, DiAcro, Model 1, used for cutting right angles in circuit boards.	1
8	Printer, NuArc, Model FT26-1, used for printing circuits on copperclad material in printed circuit board fabrication process.	1
9	Router, Ekstrom Carlson, Model 156, used for routing circuit boards down to exact external dimensions.	1

<u>Item</u>	<u>Description</u>	<u>Quantity</u>
10	Spray Etcher, Chem-Cut, Model 101, used for etching of copperclad.	1
11	Spray Etcher, Chem-Cut, Model 201, used for etching of copperclad.	1
12	Table & Oven, Grieve Henry, Model MT550, used for drying of photo sensitive circuit boards.	1
13	Vacuum, Black & Decker, Model 165, used to remove waste fiberglass in circuit board routing process.	1
14	Vapor-Degreaser, Baron Blakeslee Co., Model BK220, used to develop printed circuit boards.	1
5.	MECHANICAL/MAINTENANCE SHOP	
1	Band Saw, Powermatic, Model 87, S/N 4-5159; throat dimensions: 10-5/8" deep by 10-1/2" high, 2'x2' table.	1
2	Compressor, Quincy Corp., Model 230-30, S/N 512113LS, size 3-1/2"x3", output 125 psi.	1
3	Drill Press, Duro, Model 3080, S/N D67505, 0 - 1/2" chuck, distance from chuck to table 14-1/2", 10"x10" table.	1
4	Drill Press, Duro, Model WS3080, S/N D67508, 0 - 1/2" chuck distance from chuck to table 14-1/2", 10"x10" table.	1
5	Honer, Dry, Vacu-Blast Co., Model 3A, S/N D65-1006, 3'x3' door, consists of reclaimer and blast console, used to remove corrosion and slag.	1
6	Power Plant, Wincharger Corp., 2000 watt output, Model 2B23S4D-3M/A, S/N 27656U8.	1
7	Threader, Ridig Pipe, Ridged Tool Co., Model 535, S/N 328251, NASA #1910, 1/8" - 2" pipe capacity.	1
6.	PNEUMATICS SHOP	
1	Bender, Tube, Leonard, Model 74, S/N 32, to 3" O.D. x 3/16" wall thickness, steel, max. radius 8", hydraulic clamping and mandrel extraction, 220/440V, 3 phase, 10 hp motor.	1
2	Bender, Tube, Parker, Model 832, S/N 411, to 1-1/2" O.D., 8" radius, hydraulic drive, 115V ac, semi-portable.	1



<u>Item</u>	<u>Description</u>	<u>Quantity</u>
3	Coning and Threading Machine, Leonard, Model R1201, S/N 08, up to 1" O.D. superpressure tubing, 220V, 3 phase.	1
4	Flaring Machine, Leonard, Model 2CP, S/Ns 1853, 2926, 3633, 1883, flare and deburr tubing 1/8" to 1" O.D., split die, 220/440 V, 3 phase, 1/2 hp.	4
5	Flaring Machine, Leonard, Model 3CPHDF, S/Ns 2887, 3829, 25552, 2534, flare and deburr tubing 1/8" to 2" O.D., split die, 220/440V, 3 phase, 1 hp.	4
6	Flaring Machine, Leonard, Model 6CP, S/N 3521, flare and deburr tubing to 4" O.D., split die, 220/440V, 3 phase, 2 hp, pneumatic clamping.	1
7	Flaring Machine, Lakeland, Model 216, S/N 102, flares tubing to 1" O.D., orbital, 1 piece die, 5 hp dc motor (converted from 220V, 60 cy, ac, single phase), 0 to 1750 rpm, dc operated electric clutch/brake.	1
8	Hydrostat Test Booth, Local Manufacturer, tests to 30,000 psi using Sprague air driver pumps.	1
9	Hydraulic Systems Test Stand, Barker-Rockford, Model AHT-2C, S/N 67041-1, portable, capable of testing hydraulic systems to 5000 psi, pumps 22 gpm at 3000 psi, 10 gpm at higher pressure, 50 hp, 440/480V, 3 phase.	1
10	Laminar, Portable, Ramney, Model PCR 88, downflow clean booth, 115V, 60 cy, 40 amp.	1
11	Swager, Resistoflex, Model R3780, S/N X-72008, medium and high pressure semi-production type, socketing, crimping and expanding machine, to 2" O.D. flexible hoses.	1
12	Swager, Resistoflex, Model R21935, S/N 101011, crimps up to 1-1/2" flex hoses, medium pressure hydraulic crimping, driven by 115V ac motor.	1
13	Saw, Cutoff, Sever-All, S/N 783, Model 1A, 12" O.D., steel blade, 115V, for cutting flexible hoses.	1

## SECTION XV

### ELECTRICAL, GUIDANCE, AND CONTROL SYSTEMS LABORATORIES

<u>Item</u>	<u>Item</u>
Hygrothermograph	Capacitor Decade
Dehumidifier	Theodolite Test Fixture
Theodolite Spider	Resistor Decade
Vacuum Cleaner	Stadia Rod
Clinometer	TV Transformer
Oscilloscope Camera	TV Zoom Lens
Triangle Theodolite	TV Transmitter
Eyepiece Elbow	Aneroid Barometer
Theodolite	Electronic FCO Station and Peripheral Equipment
Precision Lift	Inertial Platform Turn-Tilt Stand
Lateral Side Adjuster	Special Purpose Computer (PTC)
Instrument Stand	Ampex FR 1400 Recorder
Tripod	Special Purpose Telemetry Processor for Guidance Computer (SAM)
Autocollimator Stand	Interface Units (DAME, ACME)
Decontamination Shoe Machine	Flight Control Computer Test Sets (IB/V)
Signal Generator	Emergency Detection System/Control Rate Gyro Test Set
Optical Micrometer	Control Signal Processor Test Set
Recorder	Accelerometer Test Set
Level	Accelerometer Tilt Table
Transit	Gyro Rate Table
Power Supply	Frequency Response Test Set
Battery Pack	CRT Display Consoles
Gram Gauge	Line Printer
Transformer	Card Reader/Punch
Theodolite Target	Typewriter Input/Output Unit
Optical Plummet	Paper Tape Punch/Reader
Height Gauge	Magnetic Tape Stations
Press Gauge	RCA-110A Computer
Oscillograph	Counters
Striding Level	Oscilloscopes
Optical Mirror	Digital Voltmeters
Space Ultra-Reliable Modular Computer (SUMC)	IC Testers
Digital Multimeters	Logic Testers
Transistor Curve Tracers	Programmable Power Supplies
Function Generators	DC Power Supplies
HP Programmable Calculators	
AD/DA Converters	

## SECTION XVI

### 1. MECHANICAL SYSTEMS LABORATORY

<u>Item</u>	<u>Item</u>
Oven	Moisture Monitor
Torque Analyzer	Lapping Machine
Drill Press	Sealer
Grinder	CEG Leak Detector
Forklift	Overhead Crane
Hydrostatic Test Unit	Timer
Heated Chemical Tank	Digital Voltmeter
Chemical Tank	Power Supply
Degreaser	Hydraulic Pumping Unit
Ultrasonic Tank	Oscilloscope
Wash Table	Dead Weight Tester
Microscope	

### 2. FLUID TEST LABORATORY

Vacuum Pump	Bechman Analyzer
Buchler Evaporator	Muffle Furnace
Flammable Storage Cabinet	Distilling Apparatus
pH Meter	Glass Washer
Oven	Water Heater
Spectrophotometer	Evaporator
Mettler Curtain Balance	Laminar-Flow Test Bench
Microscope	Black Light
Bubble Point Test Stand	

### 3. MECHANICAL SHOPS

Band Saw	Arbor Press
Horizontal Band Saw	Sander
Drill Press	Grinder
Tube Bender	

### 4. LH<sub>2</sub> MAINTENANCE SHOPS

Drill Press	Vise
Band Saw	Various Hand Tools
Bench Grinder	Work Benches
Chain Hoist	Compressed Air System

### 5. LOX MAINTENANCE SHOPS

Drill Press	Various Hand Tools
Bench Grinder	Work Benches
Vises	Compressed Air System
Chain Hoist	

## SECTION XVII

### 1. RF COMMUNICATIONS LABORATORY

<u>Item</u>	<u>Item</u>
C14-442 RF Checkout Unit	S-Band Uplink Monitor
C-14-429 Uplink Link Bench Maintenance Equipment Command System	Antenna Control Racks
C14-485 S-Band Range Transmitter Monitor	VHF/UHF Antennas
C34-348 PRN Ranging Test Set	Wideband Line Interface
C34-681 Mobile Pen Recorder	52E190004 Spacecraft Communications Test Station
C34-685 VHF Ranging System Checkout Unit	52E190019 Digital Command Monitor
Color TV Monitor	52E190020 Digital Command System (DCS) Test Set
C52-011 VHF FM Voice Unit	52E190025 DCS Test Set Tape Control
C52-012 ASTP/ATS-F Checkout Unit	LSC 410-32210 Command/Uplink Monitor
S-Band Receivers	LSC 410-32260 Digital Command Assembly
VHF Receivers	LSC 410-32280 Communications Test Set
FM/FM Subcarrier Display Rack	LDW 410-32290 Color TV Checkout Unit
	Color TV Monitor Rack